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Grinding and Finishing

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march 1957

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Valve grinding on Cincinnati 10" plain hydraulic grinder

a hitchcock publication

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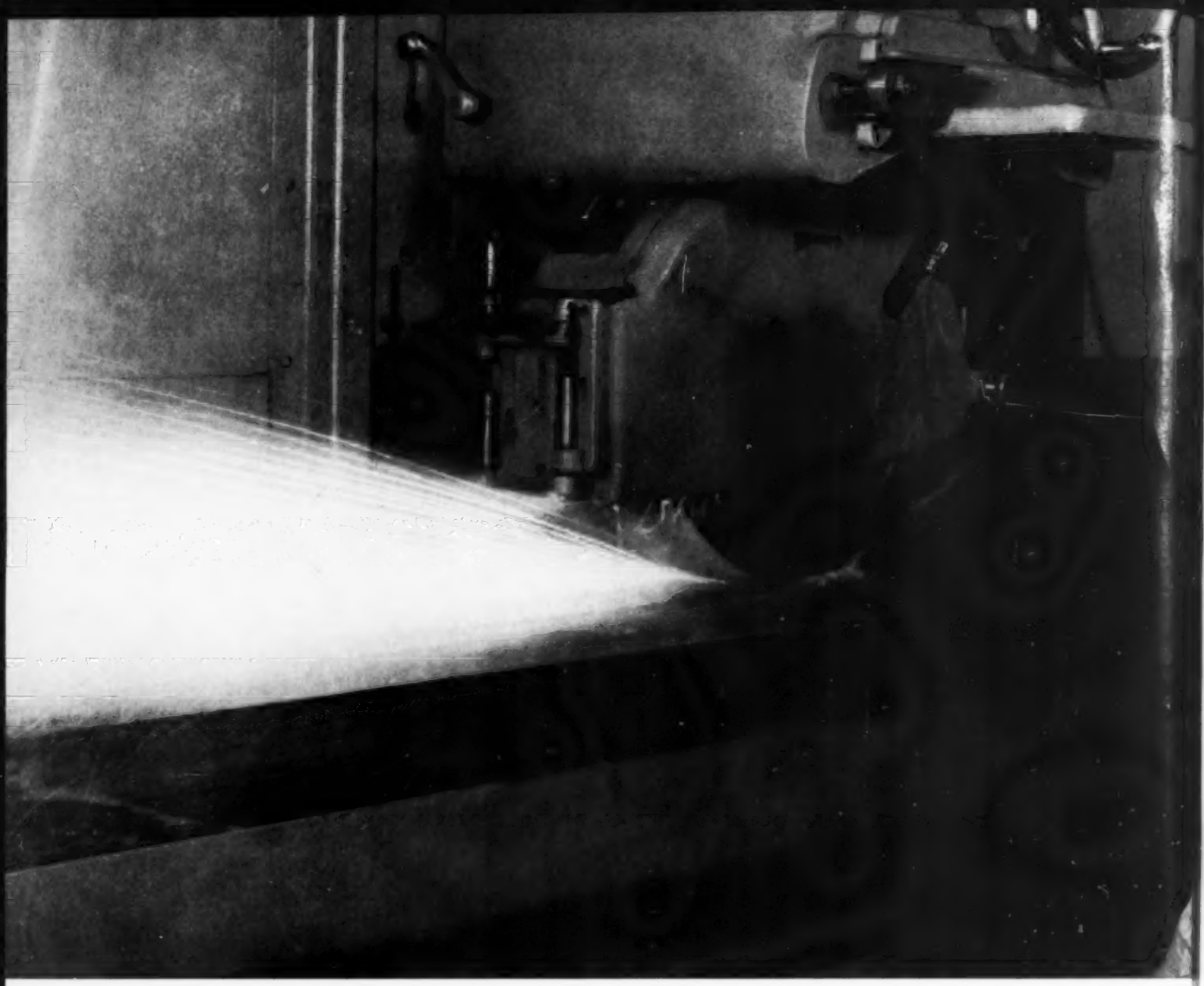

how to keep grinding dirt from loading your wheels.

Selection of a grinding fluid that allows grinding dirt to settle out quickly means fewer dressings and longer lasting wheels—to say nothing of better finish. *Texaco Soluble Oil* emulsions are extremely stable, so wheels stay free-cutting longer. And they keep the work cool, prevent distortion from frictional heat, assure a fine, rust-free finish. Use an emulsion of *Texaco Soluble Oil* for surface or centerless grinding.

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CUTTING, GRINDING, SOLUBLE AND HYDRAULIC OILS

Contents • March 1957

the magazine of abrasive metalworking operations

Grinding and Finishing

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How to Prevent Wheel Breakage by Proper Mounting of Wheels.... 31
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How to Install a 45-Ton Grinder Within 40 Feet of a Railroad 40
Machine installation problems don't come much tougher than the one which faced E. D. Jones & Sons' Massachusetts plant.

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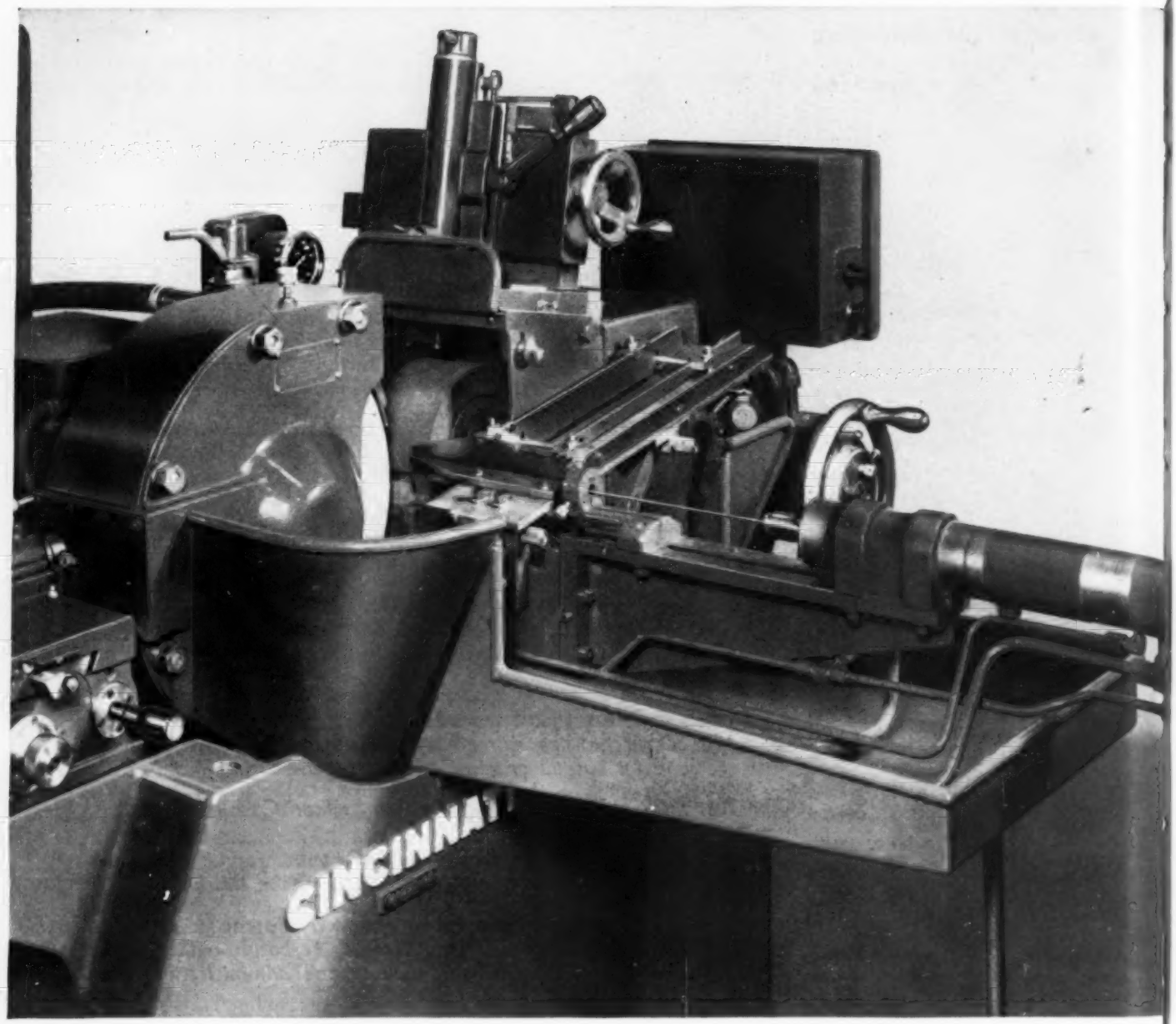
BPA

COVER: Hydraulic unit valve bushings being ground four at a time to a press fit in a previously conditioned hole in the valve body. Hole may have been reamed, ground or honed, depending on valve body material.

Cincinnati Filmatic



Letter size straight shank twist drills, No. 60 to ¼" diameter, are ground on the CINCINNATI FILMATIC No. 0 Centerless illustrated above. Operation: grind diameter and back taper. Production: 16 drills per minute. In addition to the magazine feeding attachment and loading device shown in the illustration, equipment includes a "Roto Feed" Infeed Attachment. It automatically advances and retracts the regulating wheel slide, at selective rates up to 30 cycles per minute. Tooling by Cincinnati Centerless Grinding specialists.

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CINCINNATI 9, OHIO

CINCINNATI FILMATIC
No. 0 CENTERLESS
GRINDING MACHINE
CATALOG No. G-640-1

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Letters to the Editor

Recommendations for Stainless

As manufacturers of 16 mm sound projectors we employ the use of stainless steel film channel and aperture guides. These parts are formed from type 302 stainless steel and are ground on the wear area and then given a hard chrome coating. These parts are two of the most critical parts of a projector. In our grinding operation we remove approximately .003 to .005 of material from the rails. We have had difficulty in the respect that the grinding wheels clog up after grinding a small number of parts and require a dressing operation which is rather time consuming.

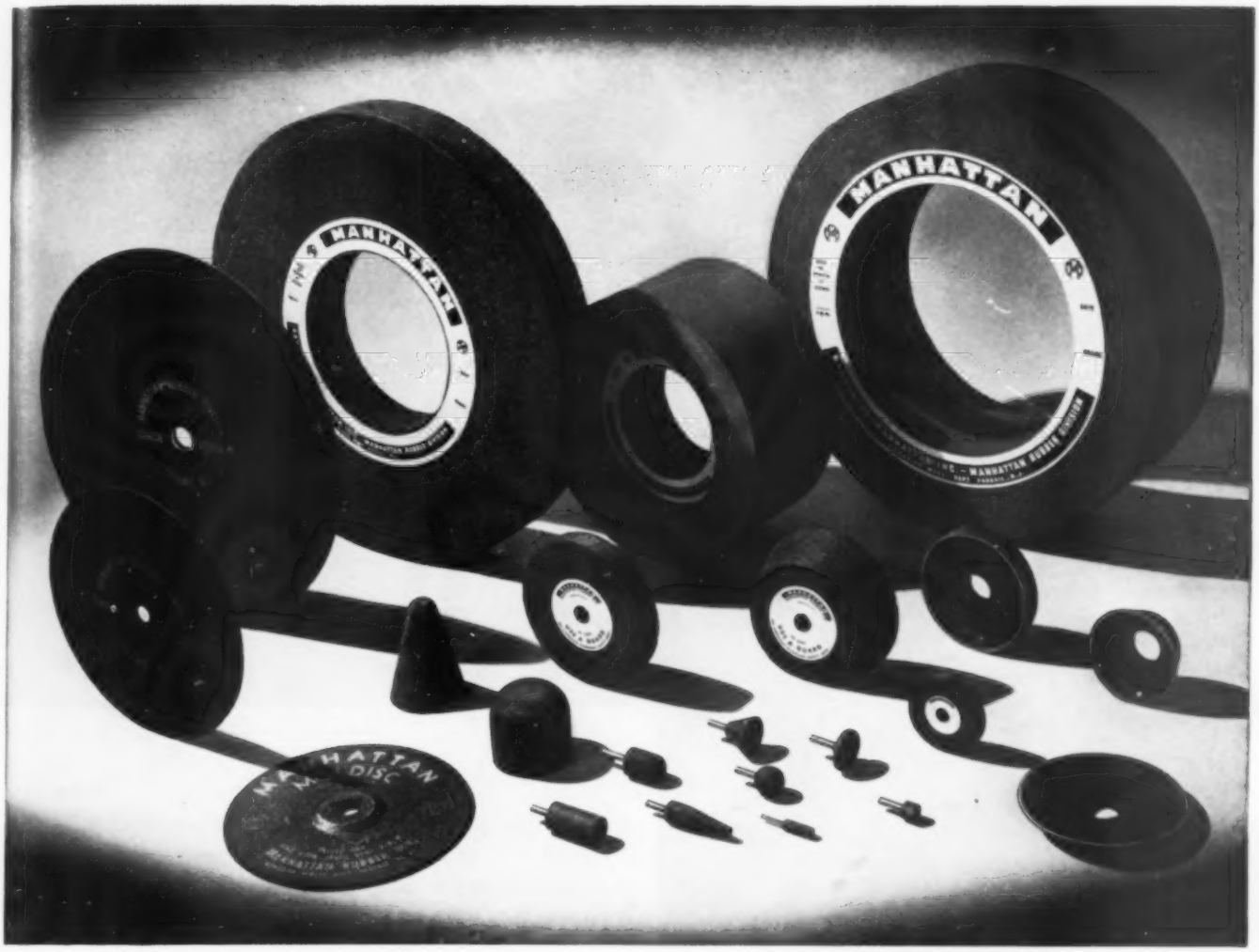
We are wondering if you folks might be able to make a recommendation to us for wheels to be used in grinding this material. As a matter of curiosity what would be the life of a diamond wheel used for this purpose?

L. J. Q.
Plant Manager
Connecticut

With some additional information on the make and model machine used for this job, the size wheel required, and the micro finish specified for the parts, we might be able to make more specific recommendations. Assuming that yours is a surface grinding job, the general wheel specifications would be aluminum oxide, grit size determined by finish specifications, H grade, 8 structure in vitrified bond. You should also investigate the possibility that you're using a coolant that is holding the grinding sludge rather than letting it settle quickly. Most grinding fluid manufacturers are able to specify the proper coolants for these applications. One such fluid that has proved very successful in stainless grinding is International 131-A.

Standard Time Data

We are wondering whether reprints



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Whatever your needs, a Manhattan Abrasive Wheel can be engineered for your particular alloy requirements. Manhattan Abrasive Wheel Specialists help solve problems at *your* plant, for faster cutting, rough grinding or finishing. Every component of the wheel they specify—abrasive, grain size, hardness, structure and bond—is custom-designed for your working conditions to remove *more* metal, *faster* . . . at *lower* cost.

Discuss your metal removal requirements with a Manhattan Abrasive Wheel Specialist. He'll show you how you can get more output per man hour . . . "More Use per Dollar".

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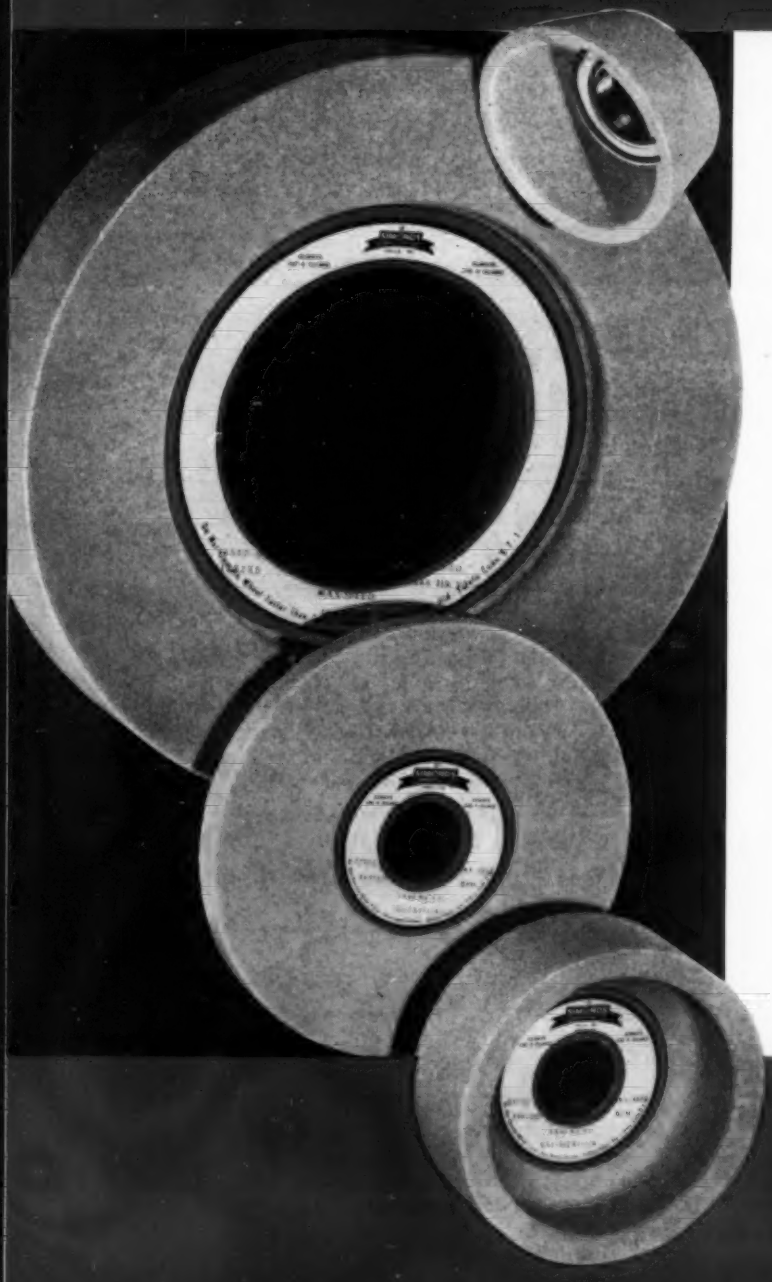

SA Borolon is a single crystal aluminum oxide abrasive possessing superior qualities over conventional white aluminum oxide abrasive. It is produced from a furnace charge consisting of a molten base with a soluble matrix which dissolves, leaving single natural crystals of abrasive grain *without crushing*.

Being single, natural crystals, each abrasive particle of SA Borolon is free of the inner stresses and strains to which multi-crystal, crushed abrasive is subjected under grinding pressures. Also, each abrasive particle contains more cutting edges, which permits greater penetration into the work and faster grinding. SA Borolon has the greatest surface hardness yet achieved with aluminum oxide type abrasives. Write for illustrated Catalog Bulletin ESA-272.

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TRADE MARK

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Because of its tough, hard crystal structure, SA Borolon bites into the work, and fractures before point dulling can set up frictional drag, with consequent risk of damage to steel temper.

FASTER CUTTING

Because SA Borolon is made up of a single, unbroken crystal with multiple cutting faces, over its entire surface it provides a regular sequence of sharp edges on the wheel face. This differs radically from ordinary blocky grain in which blunt faces are interspersed with cutting edges.

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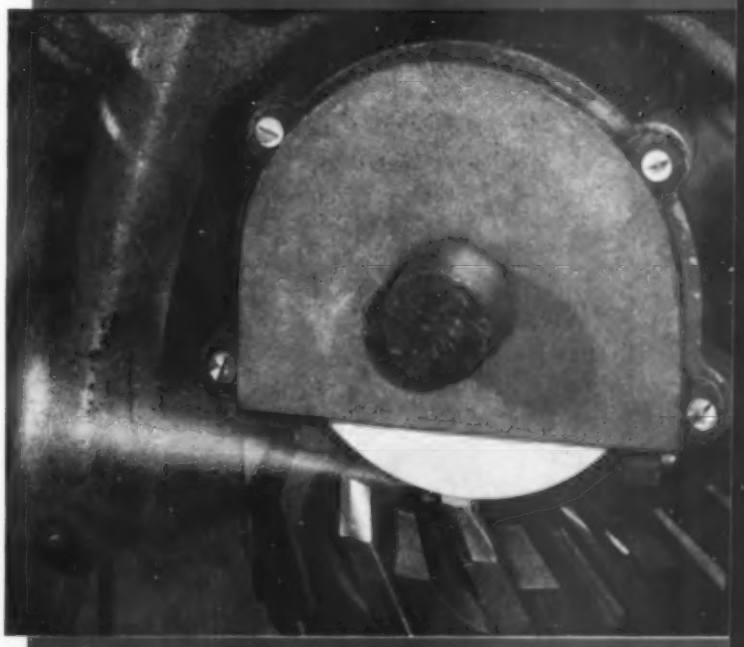
Because SA Borolon has (1) increased resistance to dulling and (2) fractures so as to increase the "self-sharpening" feature of the wheel, less dressing is required and wheel life is prolonged.

BETTER FINISH

The sharp, free, cool-cutting action inherent in the single crystal structure of SA Borolon, means improved finish on *your* toolroom grinding jobs.



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SOLUTION—

One, standard design, Murray-Way ten station indexing dial-table, with special features.

Eight, universal floating type, Murray-Way polishing heads, with special overhead mounts.

One, special Murray-Way engineered control system.

Ten, Murray-Way designed mounting fixtures.

RESULT—A high production, easily operated polishing set-up with a minimum of occupied floor space. Retractable heads for convenient wheel change. Overhead, head-mounts afford maximum open floor space. Push button controls. A unique, automatic wheel-pressure hunting device. Sturdy dial-table with oversize center-bearing and special anti-friction, hardened rollers for outside support, to reduce wear. Automatic indexing mechanism with continuous motion or adjustable dwell. The entire installation engineered by Murray-Way for easy interchange of fixtures and parts accommodating a wide variety of work.

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are available for the series of articles which you have been running in Grinding and Finishing magazine, concerning development of standard time data for grinding.

If such reprints are available, we should like very much to receive two (2) copies for our production department.

Charles E. Gilbert, Jr.
Vice President
The Cincinnati Gilbert
Machine Tool Co.

While looking through your November issue of Grinding and Finishing, I came across Part 2 of the article entitled "Developing Standard Time Data for Grinding Operations." I am sure these articles would be very valuable to us in our work. Therefore, I would appreciate three copies of each of your magazines containing the aforementioned articles.

I shall be glad to pay any fee this may entail.

C. J. Frampton
Ass't. Time Study Supervisor
Chrysler Jet Engine Plant

Centerless Grinding

We started receiving copies of your magazine in January, 1956. Looking back thru the issues I came across a featured article, "Centerless Grinding," Third of a 5-Part Series in the January, 1956 issue.

I would appreciate receiving four reprints of the complete 5-Part Series on "Centerless Grinding." Please advise if there is a charge and if there is, we will submit a check immediately.

H. L. Freer
Landis Tool Co.

Reprints of the centerless grinding series are available at 35 cents per copy. A complete list of GRINDING and FINISHING reprints follows the Letters to the Editor column.

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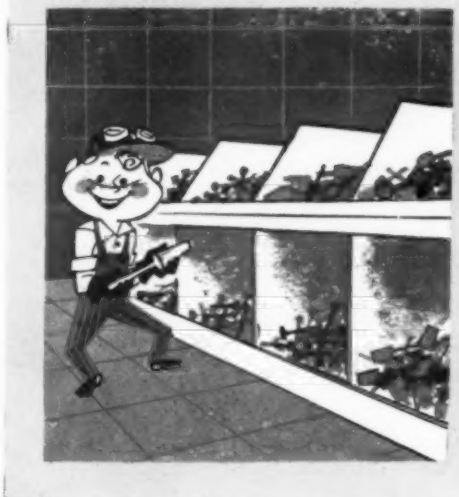

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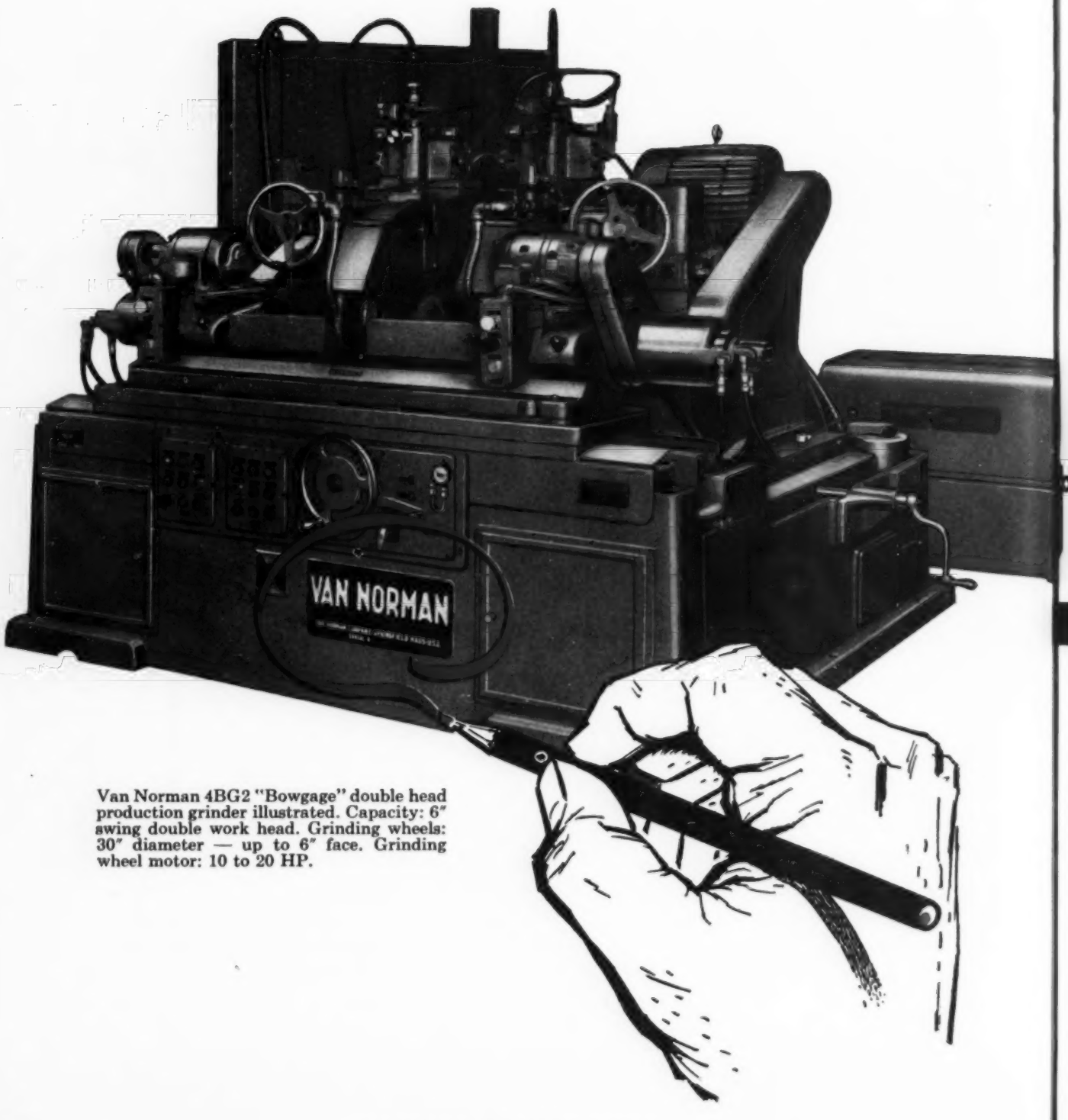
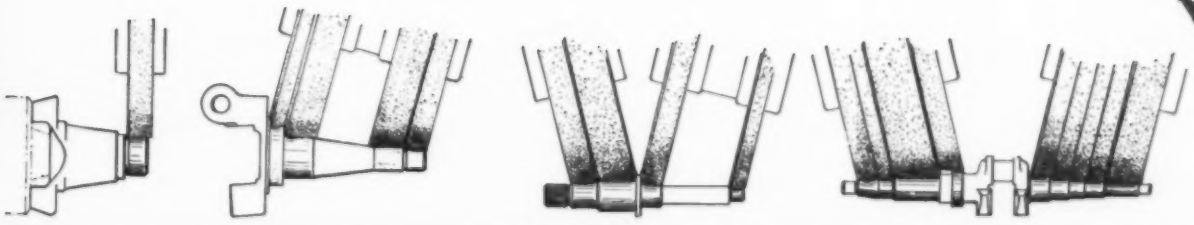
The Accent is on



Van Norman 4BG2 "Bowgage" double head production grinder illustrated. Capacity: 6" swing double work head. Grinding wheels: 30" diameter — up to 6" face. Grinding wheel motor: 10 to 20 HP.

Production

when you use a
VAN NORMAN "BOWGAGE" PRODUCTION GRINDER



Here are sketches of several actual applications performed for users of single and double head Bowgage Production grinding machines.

"Engineered for the job," the Van Norman 4BG "Bowgage" Production Grinder gives you accurate, fast, economical mass production.

Actual case histories on these massive grinders continually show substantial savings by keeping production up and costs down.

Van Norman production grinders can help you with your mass production problems. Write, wire or telephone, today, for complete details on the Van Norman 4BG "Bowgage" Production Grinders.

Don't wait . . . for extra profit install a Van Norman "Bowgage" Production Grinder now! They are available in many purchase plans . . . Outright sale . . . Purchase on conditional sales contract up to five years . . . Pay as you depreciate up to 10 years. Conditional Sales Contracts not available to Export.

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Reprints

Available on request are the following free GRINDING and FINISHING reprints:

1. **Precision Grinding and Lapping at Sundstrand Aviation** by Jack Kenyon. Summary of interesting operations on aircraft accessory parts in one of the nation's leading high-precision shops.
2. **Determining Diamond Concentration in a Diamond Wheel** by F. W. Lindblad. Concentration of diamond particles, their size and arrangement all vitally affect diamond wheel performance.
3. **Belt Grinding Gas Turbine Parts** by Leo F. Byrnes. Belt grinding operations are vital to production of General Electric stationary gas turbines.
4. **Classifying Tool Steels by Grinding Characteristics** by J. A. Weir. Selection of proper grinding wheels for tool steel grinding.
5. **Finish Measuring Techniques** by E. W. Bolles. Keep up with the latest ASA standards on surface roughness.
6. **Workholders and Drivers for Precision Grinding** by Harry Conn. A summary of recent developments in workholding devices.
7. **Gear Honing.** New Process uses honing principles to generate gear teeth. Improves gear sound characteristics.

Also available, at 35c per copy:

8. **Centerless Grinding** by G & F Editorial Staff. Reprint of a comprehensive five-part treatise on centerless work, including advantages, applications, economics, fundamentals, methods, machines, attachments, blades, setups, wheels and common troubles encountered.
9. **Organizing and Operating a Precision Barrel Finishing Department** by Morris S. Shipley and William A. Biebel. How yesterday's rough-and-tumble methods have given way to precision barrel finishing. 30-page report covers applications and limitations, selection of equipment, media and compounds, methods and hints to operators, and organizing and operating a department.

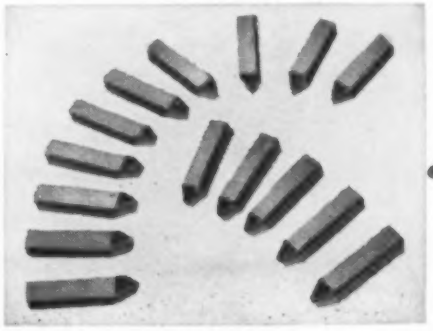
Address reprint requests to: GRINDING & FINISHING. 222 East Willow Ave., Wheaton, Ill.

FORGING DIE

Material: Heppenstall 'A'
Conventional Machining
Time: 40 hours
Elox Setup & Machining
Time: 8 hours
Saved: 32 hours
Machine tool: Elox Standard M-500
Electrode: Cast Elo-met #3
Customers report 75% time saving in re-working dies after washout . . . no annealing is necessary.

TUNGSTEN CARBIDE SINGLE POINT TOOLS

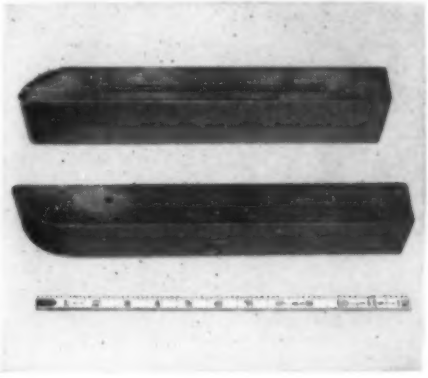
E D M produces 14 identically machined tools per hour. Times include roughing and finishing, machining both faces, nose radius and top. Radius held to ± .001". Tools were produced by 1 man operating 2 Elox Tool & Cutter Grinders, using a brass wheel. Users report Elox ground tools give greatly increased life when compared to abrasive ground tools.



EMBOSSING DIE

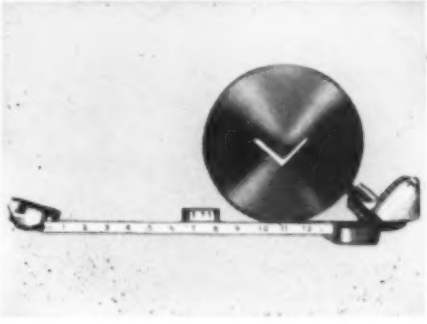
Material: Air Hardened Tool Steel
Die consists of 1,250 squares machined .100" x .030" deep in the bottom section of the die. Sharp corners on each square had to be maintained.

Conventional Machining
Time: 227 hours
Elox Setup & Machining
Time: 10 hours
Saved: 217 hours
Machine Tool: Elox Standard M-500
Electrode: Free machining brass



EXTRUSION DIE

Material: Air Hardened Tool Steel
Conventional
Machining Time: 4 hours
Elox Setup &
Machining Time: 1 hr. 38 min.
Saved: 2 Hrs. 22 min.
Machine Tool: Elox Standard M-500
Electrode: Free machining brass
Machining is done after final heat treating . . . eliminating the possibility of distortion.



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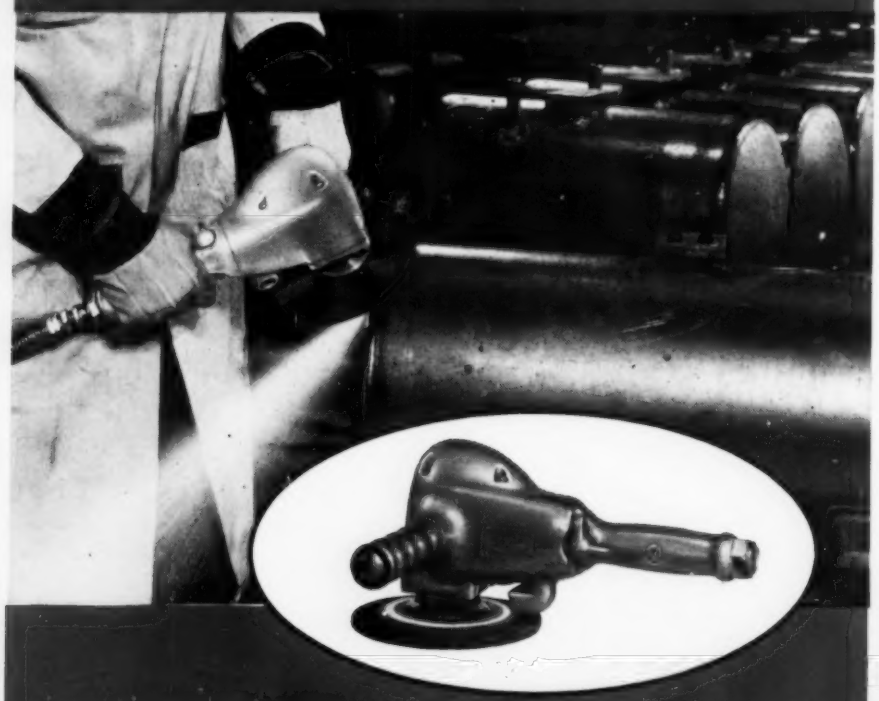

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Positive, accurate control of air-flow from zero to full speed—because the twin-trigger throttle is right where it belongs for easy, thumb-flip operation.

Perfectly balanced, easy to handle—because it's an angle tool . . . gearless efficiency and direct air-flow because it's a vertical tool.

Takes 4", 5", 6" cup wheels—because it's a grinder . . . takes 5", 7", 9" sanding pads—because it's a sander.

It's also the busiest abrasive tool you'll ever have in your plant—because it's the NEW Buckeye "E" Series Vertical-Angle Grinder-Sander, fully described in our Catalog A-10. May we send you your copy?

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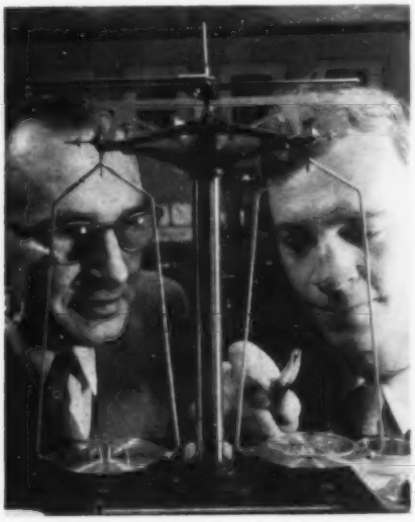
Industry Observer

Discovery by GE scientists of Borazon, a man-made substance "in the same general range of hardness as diamond and thus many times harder than the next-ranking materials in the hardness scale," may forecast a revolution in the field of industrial diamond tools. Borazon, GE explains, will withstand temperatures of over 3500°F, compared with diamond's 1600. The material has been made only in very small experimental lots in processes similar to the one which first produced synthetic diamonds two years ago.

In lapping tests Borazon (defined as the cubic form of boron nitride) polished away the surface of a large diamond at the same rate as diamond powder, indicating a hardness about the same as diamond for the new material. "Superpressures" above 1,000,000 pounds per square inch and temperatures exceeding 3000° F are used to produce the cubic boron nitride crystals.



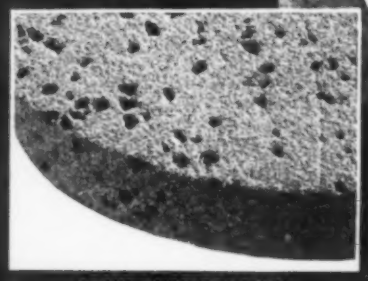
Clusters of borazon are weighed by the discoverer of the new material Dr. Robert Wentorff (right). Anthony J. Nerad (left) is manager of the mechanical investigations section at the General Electric Research Laboratory, whose investigations have produced synthetic diamonds and borazon.

Ford's 1957 truck line, originally not scheduled for production until 1958, were introduced by Ford dealers February 1. The Ford line represents the biggest change in the history of the company, and cost $77,000,000 to design and put into production.

NEW

MACKLIN

INCREASES PRODUCTION ON ALL TYPES OF CARBIDE GRINDING



CONTROLLED POROSITY
Note the open pore structure on this close up of a Macklin V-8 Wheel.

The new Macklin V-8 Wheel sets new standards of grinding performance. OPERATORS LIKE IT because of its soft, smooth "feel". It's easy on the wrists, easy on the tools, *cuts faster with less push.*

MANAGEMENT LIKES the long wheel life of the V-8 wheel, the way it increases production and cuts operator fatigue.

V8 *CUTS FASTER WITH LESS PUSH*

V8 *EASIER ON TOOLS*

V8 *EASIER ON OPERATOR*

V8 *HAS A SOFT, SMOOTH "FEEL"*

TEST V8 ON YOUR OWN JOB

It's a fact. Test the new V-8 Wheel on any one of your carbide grinding jobs and you'll switch! You get faster, cooler cutting . . . longer wheel life. But don't take our word for it. Test the V-8 Wheel *in your own plant . . . on your own job*

FOR A DEMONSTRATION WITHOUT OBLIGATION, CONTACT YOUR NEAREST MACKLIN DISTRIBUTOR OR CALL FOR THE SERVICES OF A MACKLIN FIELD ENGINEER.

V8 THE NEWEST IN MACKLIN'S "WHEELS OF PROFIT" FOR INDUSTRY

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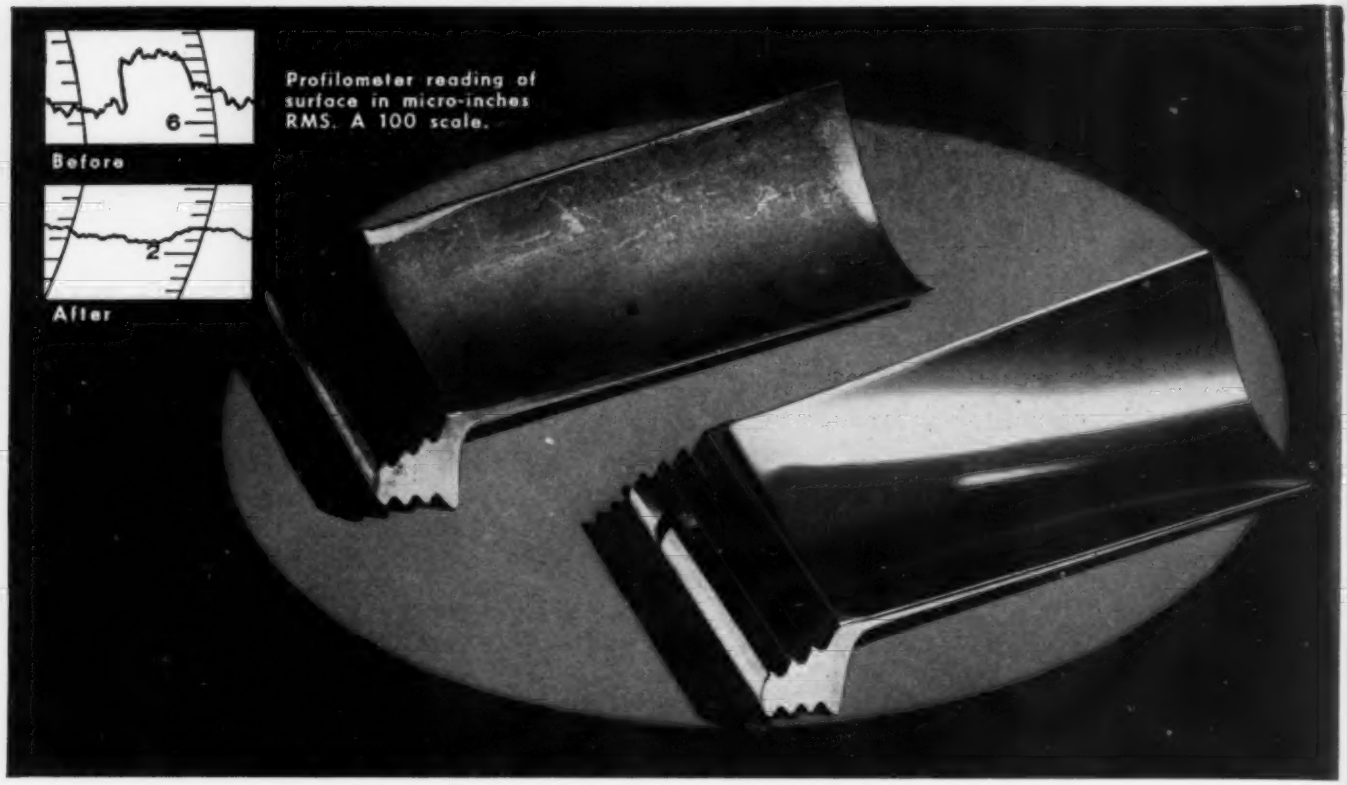

Cut parts finishing costs, maintain exact tolerances, get absolute uniformity with *Roto-Finish* processes

Roto-Finish, pioneers in precision barrel finishing, offer you a complete finishing service. Savings on deburring, descaling, grinding, polishing, coloring and surface improvement are tremendous. Expensive hand finishing methods can be eliminated.

Roto-Finish processes are controlled to produce the finish you need with no significant dimensional changes. You get absolute uniformity of finish in quantity lots.

Many prominent manufacturers now using Roto-Finish processes are saving money on finishing costs. (Names on request).

ROTO-FINISH CHIPS, COMPOUNDS AND MACHINES ARE OF THE HIGHEST QUALITY

Roto-Finish has never sacrificed quality for the sake of price. Through the years, Roto-Finish has carried on a continuous program of process and product improvement to meet the needs of modern industry. When you choose Roto-Finish processes, you can be sure that you are getting the best in supplies, equipment and complete continuing engineering service.

ROTO-FINISH GUARANTEES RESULTS

There is no costly trial and error involved in the purchase of Roto-Finish equipment. You submit unfinished parts to Roto-Finish along with a finished sample and a description of the finish you require. These sample parts are processed in the Roto-Finish Sample Processing Laboratories, where experienced engineers determine the combination of chips, compounds, and machine required to do the job. Roto-Finish guarantees to reproduce the same results in your plant, using the Roto-Finish processes, that are achieved in sample processing. This service demonstrates for you exactly what you can gain by using Roto-Finish processes.

The sample processing service is available to help you with your finishing problem. Take advantage of this opportunity to save on finishing costs. Send samples of finished and unfinished parts and details of the type of finishing equipment available in your plant.

SEND FOR THIS FREE TECHNICAL DATA FOLDER

It describes the basic process, chips and compounds and the complete Roto-Finish line of standard and special machines.

Roto-Finish COMPANY

3730 Milham Road, Kalamazoo, Mich.

P. O. Box 988

Phone: FI 3-5578

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BRAZIL—Commercial E. Industrial de Fornos Werco, Ltda.—rua General Gurjao, 326—Rio de Janeiro
CANADA—Canadian Hanson & Van Winkle Co., Ltd.—Cor. Silver and Morrow Avenues—Toronto
ENGLAND — Roto - Finish Limited — Mark Road, Hemel Hempstead — Hertfordshire
FRANCE — Societe Roto - Finish — 40-42 rue Chance Milly — Clichy (Seine) — Paris
GERMANY, AUSTRIA, NORWAY, SWEDEN, SWITZERLAND — Metallgesellschaft A. G. — Reuterweg 14 — Frankfurt a. M. — Germany.
HOLLAND, BELGIUM, LUXEMBURG — N. V. Roto-Finish Maatschappij — Rotterdamseweg 370 A. Delft, Holland.
ITALY — Societa Roto - Finish a R. L. — Sesto S. Giovanni — Viale E. Marelli, 31 — Milan
SPAIN — Instituto Electroquimico, S. A. — Corcega 58 — Barcelona

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30 minutes were cut to 18 seconds when this vertical platen belt grinder replaced a lathe in shaping boroscope mirrors. Cut at an angle from round bar stock, they need to have their bottom angle shaped to match the top angle, an operation accomplished by placing them in a fixture and rotating them against a moving Speed-wet Durite belt. This "Abrasive Tech" method is an example of the Behr-Manning technical service that may provide more production efficiency for your plant.

A Behr-Manning methods engineer can often give valuable aid in overcoming stubborn finishing problems. All you have to do is call the nearest Behr-Manning office. Seventeen well-equipped "Abrasive Tech" Methods Rooms are waiting to show you the newest techniques: Atlanta, Boston, Buffalo, Chicago, Cincinnati, Cleveland, Detroit, Grand Rapids, High Point, Indianapolis, Los Angeles, Teterboro, Camden, San Francisco, Seattle, St. Louis, and Brantford, Canada. Main office and plant: Troy, N. Y.
For export: Norton Behr-Manning Overseas, Inc., New Rochelle, N. Y., U.S.A.

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Let's toss a bouquet to the modern super-market — one of the greatest time and trouble savers in present-day living.

But, have you ever stopped to think that, in the abrasives field, Norton brings you real super-market convenience? Here, in the world's largest line of abrasive products, is everything you need for every grinding job.

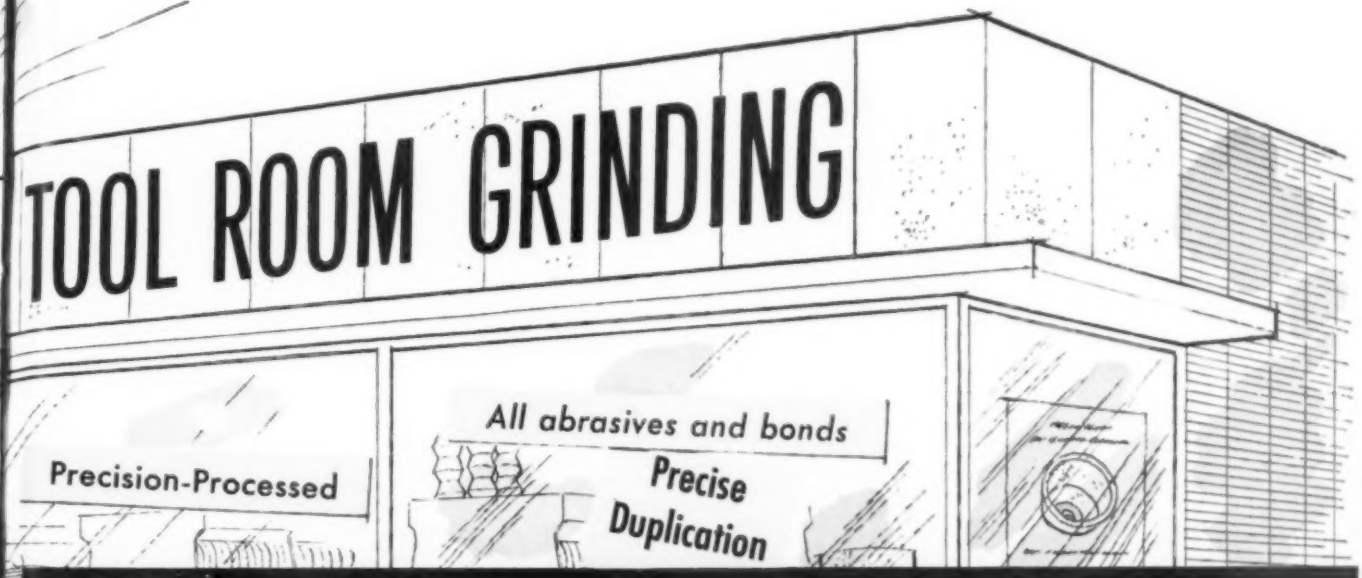
Take tool room grinding wheels. In these, as in all other categories, the Norton line is 100% complete. You don't have to shop around — going to one source for wheels that will sharpen steel tools, to another for diamond wheels, to another for mounted wheels.

You can get them all at Norton. And they're all the best wheels that can possibly be made. The advanced equipment and broad experience you find at Norton you'll find nowhere else in abrasives manufacture.

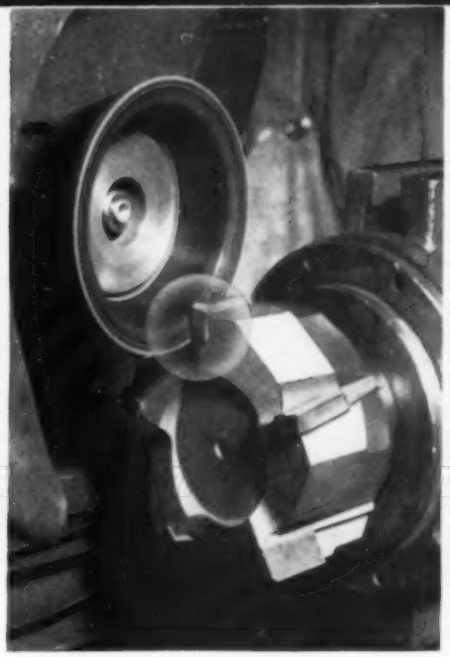
Advantages like these mean leadership. And they result in precision-processed, precision-performing wheels that grind exactly alike — from wheel to wheel and lot to lot.

See Your Norton Distributor for wheels that will bring the value-adding, profit-boosting "Touch of Gold" to all your tool room grinding operations. Ask him for the two helpful booklets — *A Handbook on Tool Room Grinding* and a booklet on *How To Select Wheels For Precision Grinding Tool And Constructional Steels.* Distributors in all industrial areas, listed under "Grinding Wheels" in your phone directory, yellow pages. Behr-Manning Company, Troy, N. Y., a division of Norton Company. *Export:* Norton Behr-Manning Overseas Incorporated. **For the booklets or other information write to Norton Company, Worcester 6, Mass.**

TOOL ROOM GRINDING



FOR SHARPENING STEEL TOOLS, as well as for surface, cylindrical and internal grinding on all steels, Norton G Bond and BE Bond Wheels — in 32 ALUNDUM*, 38 ALUNDUM, 19 ALUNDUM or the new non-premium priced 44 ALUNDUM abrasive — add the money-saving, cost-cutting "Touch of Gold." These vitrified bonds are the most efficient ever developed for precision and semi-precision grinding.



FOR CARBIDE GRINDING, Norton diamond wheels are the recognized "Crown Jewels." Made in the regular B resinoid bond for wet grinding and the B6 resinoid bond for dry grinding. For many carbide grinding jobs Norton K Bond CRYSTOLON* wheels are often the best investment.

FOR DIE AND MOLD FINISHING Norton mounted wheels bring you big savings on the widest range of tool room jobs. They're a 100% complete line, for all requirements.

*Trade-Marks Reg. U. S. Pat. Off. and Foreign Countries

NORTON
ABRASIVES

Making better products...
to make your products better

NORTON PRODUCTS: Abrasives • Grinding Wheels
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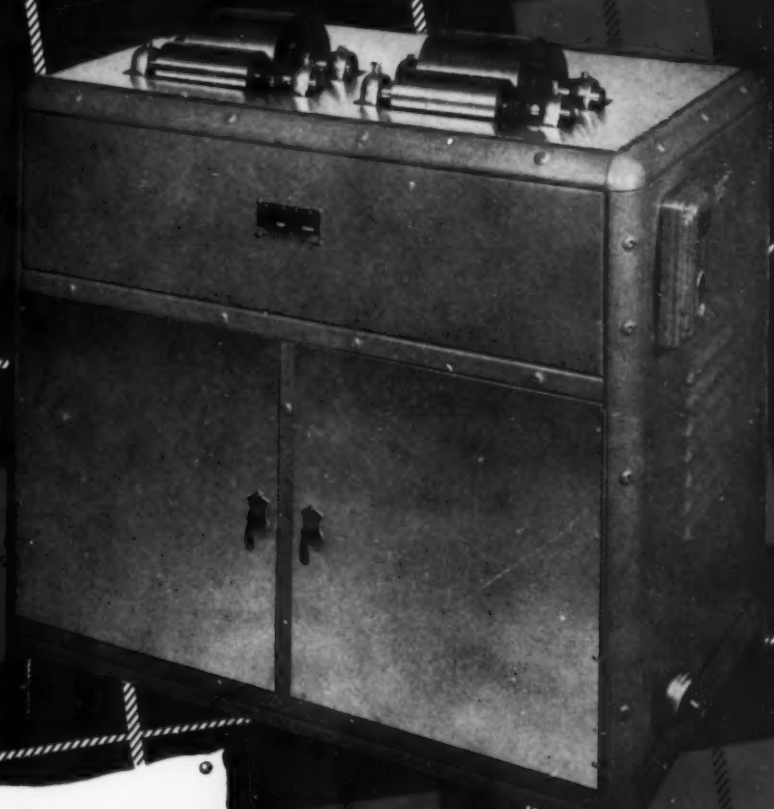
1½ MICROINCH FINISH RMS

At Less Cost!



Today Size Control Centerless Lapping Machines are:

- ✓ Providing finishes of 1½ microinches or less and tolerances of .000005
- ✓ Lapping oversize bearings and gears
- ✓ Lapping and sizing bearing races, bushings, shafts and cylindrical parts

How They Are Saving Money for People Like You:

- ✓ Salvaging worn gages by reducing to next lowest size
- ✓ Saving shop space—dimensions are only 38" wide, 24" deep, 36" high
- ✓ Special operating skills, costly set-ups, ring laps, special tools, *not needed!*

Prices Are Right:

- ✓ Model 100 ....$850.00 complete
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Availability:

- ✓ 24 hours

May we have your order? Phone, wire (collect), or write today.

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. . . famous for their leadership, practical wisdom, and thrift for over 800 years.

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INDUSTRIAL ENGINEER AT ALCO VALVE CO. REPORTS...

"We stepped up parts production 700% by deburring and polishing with ALMCO EQUIPMENT"

MR. HAROLD KRAUSHAAR, Industrial Engineer at Alco Valve Co., St. Louis, shows solenoid valve parts on which Almco barrel finishing equipment recorded vital production increases.

KEEPING PACE with over-all stepped-up plant production requirements was not easy at Alco Valve when it came to finishing of piston and plunger valve parts.

These stainless steel screw machine parts were being deburred and polished by hand at the rate of slightly over 200 per hour.

It threatened to become a bottleneck, and in addition, stricter finishing specifications were calling for 25 micro-inch on both plungers and pistons, further increasing man hours.

FINISHING PRODUCTION SOARED — After detailed lab analysis and testing procedures on typical parts by Almco engineers, an Almco Model DB-400 barrel finishing machine was installed. Production rate on deburring and polishing rose from 200 per hour to over 1400 per hour — a direct increase of 700%! Plant production schedules were met without difficulty.

REJECTS PRACTICALLY ELIMINATED — The Almco method of deburring and finishing not only mastered the stricter micro-inch requirements, but cut rejects to a bare minimum. Since hand operations were completely eliminated, costly variables were no longer present.

MODERN TECHNIQUES IN BARREL FINISHING — It will pay you to investigate what Almco barrel finishing can do for your company. Almco's technician-staffed laboratories can help you by examining your product parts, running them through detailed sample processing to determine what combination of machine, compound, media, cycle, etc., will produce the results you want, at lowest possible cost.

All you have to do to get a complete report with absolutely no obligation is to write Almco, asking an engineer to call and arrange it. Or, send sample parts and specifications on results desired direct to Almco's main laboratory at Albert Lea, Minnesota.

You will be interested to know that Almco case history reports now cover a tremendously broad variety of parts, metals, and finishes. Get information on your requirements now!

Deburring and polishing of piston parts is a smooth one-operation process at Alco Valve. After O.D. centerless grinding and angle seating, parts are processed to tight specifications in this Model DB-400 Almco machine.

SEND FOR THIS NEW BARREL FINISHING HANDBOOK

Complete description of the most advanced modern processes. 52 pages of facts, photos, data and cost comparison charts. Write for your personal copy today.

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133 Marshall Street • Albert Lea, Minnesota

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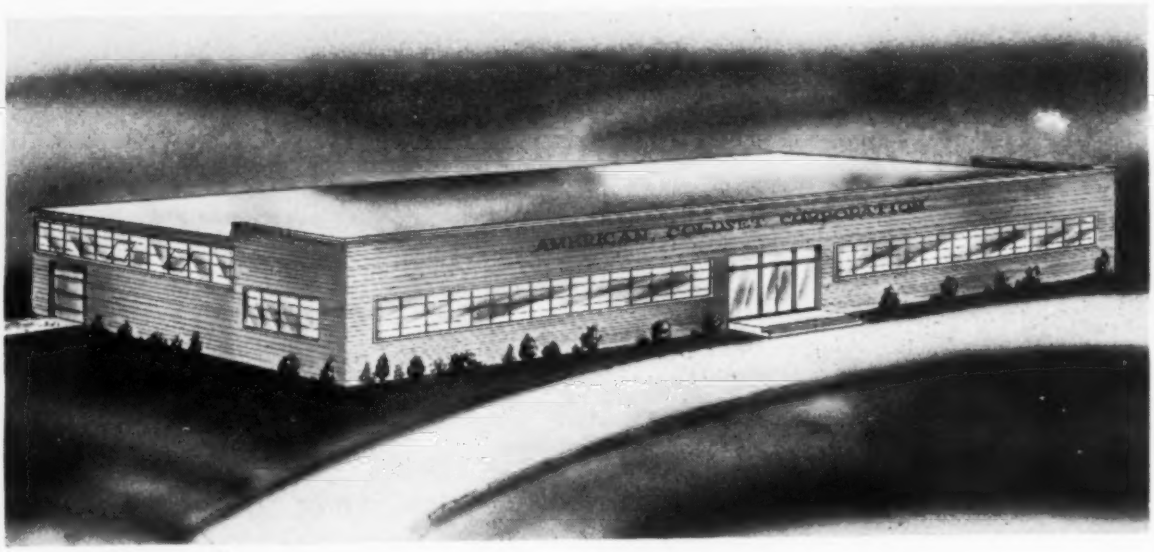
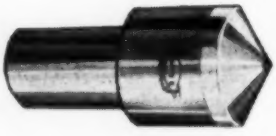


the date April 1957

the place Teterboro N. J.



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makers of diamond tools,

diamond wheels & core bits!

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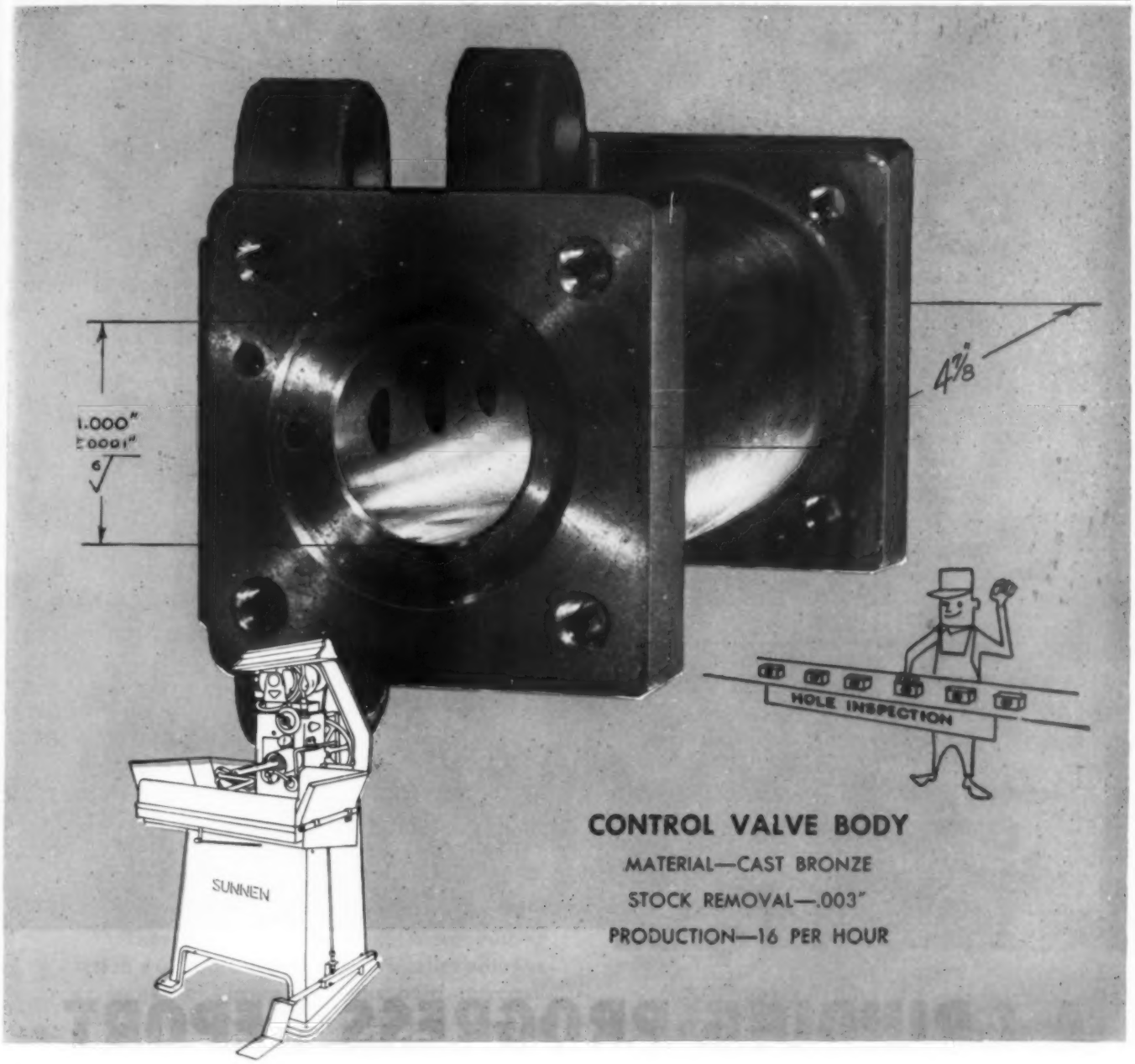

CONTROL VALVE BODY

MATERIAL—CAST BRONZE

STOCK REMOVAL—.003"

PRODUCTION—16 PER HOUR

ELIMINATE SCRAP AND SALVAGE
...WHERE PARTS REQUIRE PRECISION BORES

In precision bore-sizing, the slightest error means substantial scrap loss . . . or expensive salvage operations which are often uncertain.

If you have trouble holding tolerances (size and finish) by boring, grinding or reaming . . . you need Sunnen Honing. It does the job faster, better, cheaper . . . and it's reliable!

Sunnen Honing Machines hold any tolerance or finish required . . . with controlled stock removal to thousandths or tenths as desired. No fixtures, no chucking, no set-up time! Built-in controls assure high production rates with minimum gaging time.

SUNNEN HONING KEEPS YOU OUT OF THE SCRAP AND SALVAGE BUSINESS...

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A GRINDING PROGRESS REPORT

Extra Fine Grit Silicon Carbide Succeeds in Tough Vasco Supreme I. D. Grinding Job.

One basic fact affects wheel selection for all internal grinding: Only light infeed pressure is possible. With the wheel mounted at the end of a long, slender spindle, too much pressure would cause deflection and distort the hole. The relatively large area of grinding contact further reduces the infeed pressure. Also, small wheels and high spindle speeds mean limited driving power.

On extremely hard, tough metals, the problem of finding the wheel to grind efficiently becomes critical. For harder metals it is usual to use softer grinding wheels, but there is a limit. It comes when the wheel is so soft it will not hold shape, requires frequent dressing for re-truing, and wears out quickly.

W. H. Nichols Co., Waltham, Mass., faced a challenging problem in production grinding the I.D. of spur pump gears made of Vasco Supreme, Neatro, or Ohio Air Die steels hardened to 58 - 64 Rockwell C.

Gear pumps made for the synthetic yarns industry by W. H. Nichols Co., require hard, abrasion-resistant steels.

W. H. Nichols Co. Foremen Rousseau and Burns, and Abrasive Engineer Pete Wilson checked closely on production, quality, and wheel performance with operator, during trials.

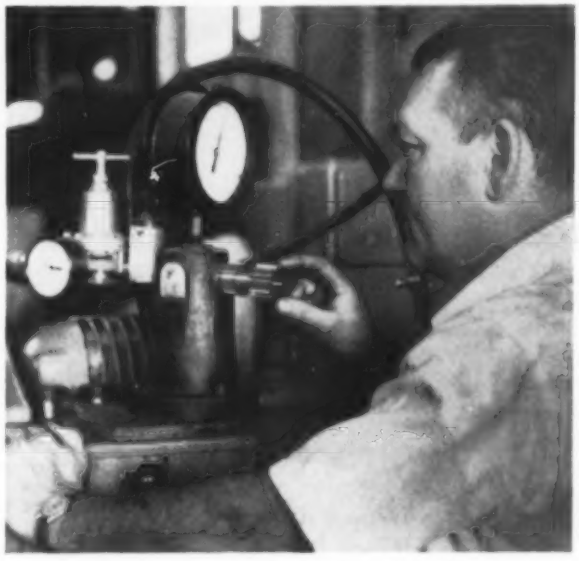
There, Bay State Distributor Engineer Pete Wilson worked closely with "Skipper" Burns, Production Foreman, and Hector Rousseau, Grinding Foreman. First, they reasoned that for these materials of high carbide content, Silicon Carbide abrasive would penetrate better and give cleaner cutting than the Aluminum Oxide being used.

They also reasoned that more cutting action would occur if more and smaller abrasive grains were cutting into this hard material. Instead of the normal grit sizes of 80 - 90, they tried grits ranging from 150 to 240.

How right they were is proved daily, in W. H. Nichols' production figures and grinding costs. Using 240 grit Silicon Carbide on the Vasco Supreme, and 150 grit on the Neatro and Ohio Air Die steels, their grinding wheels now have three times the old life. Dressing, which formerly removed .008" of the wheel each cycle, now takes only .001", just enough to keep the wheel sharp. With the extra fine grit sizes, the wheels grind more efficiently and hold shape excellently. Production schedules are being met with gears of fine dimensional accuracy, 50 or more being completed per wheel.

Top ranking abrasive engineering skills like those used in this case are available to you for your grinding. Contact your local Bay State distributor, any branch office, or the Bay State Abrasive Products Co., Westboro, Massachusetts.

Improved finish (5 micro-inch) from the finer grits also gives greater accuracy in the air-gaging.



Branch Offices are located in Bristol, Conn.; Chicago, Ill.; Cleveland, Ohio; Detroit, Mich.; Pittsburgh, Pa.; with distributors in all principal cities.

In Canada: Bay State Abrasive Products Co., (Canada) Ltd., Brantford, Ont.

BAY STATE ®
WHEELS of PROGRESS

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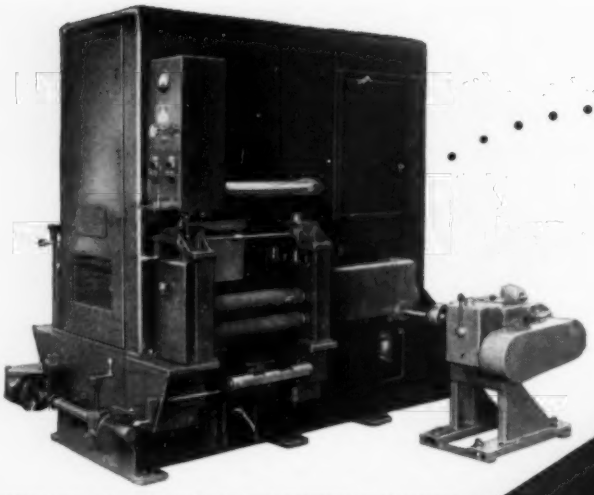
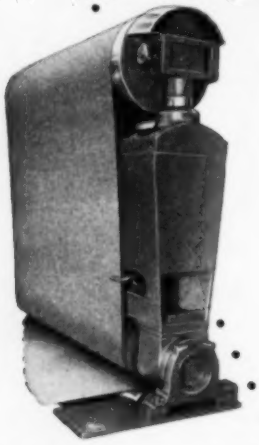
hard, abrasion-resistant steels.



ABRASIVE BELT GRINDING & POLISHING MACHINE
(Pinch Roll Type)

For pre-finishing, conditioning and polishing sheets, plates, strips or blanked-out shapes in flat form. Used as single units or in multiple units for progressive line polishing.

for FINISHES
that pass inspection
the FIRST TIME get a HILL
Grinding & Polishing Machine



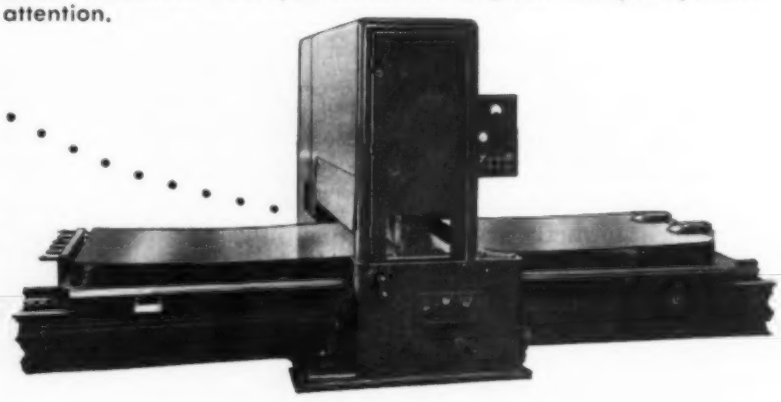
The basic HILL two-roll vertical head with endless abrasive belt. Used in both the Pinch-Roll and the Hydraulic Table types.

● HILL 2-ROLL Vertical Abrasive Belt Grinding and Polishing Machines are made in two general types for producing superior finishes on flat surfaces as required by manufacturers of a wide variety of products such as decorative plastics, auto bumpers, engravers plates, home appliances, etc.

Both types are built in polishing widths up to 60" and larger sizes can be furnished if desired. Your problem will be given our prompt and careful attention.

ABRASIVE BELT POLISHING MACHINE
(Hydraulic Table Type)

For flat polishing of sheets and plates of ferrous and non-ferrous metals. Made in a variety of table widths and lengths with full hydraulic reciprocating table.



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"HILL" GRINDING & POLISHING MACHINES • HYDRAULIC SURFACE GRINDERS • ALSO MANUFACTURERS OF "ACME" FORGING • THREADING TAPPING MACHINES • "CANTON" ALLIGATOR SHEARS • BILLET SHEARS • PORTABLE FLOOR CRANES • "CLEVELAND" KNIVES • SHEAR BLADES

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grinding and finishing

Editor's Page

It's Only a Matter of Pruning

". . . must reduce expenditures for supplies and materials"; ". . . can't we cut costs on these abrasive supplies?" ". . . let's put someone on to this and cut down on the purchases"; ". . . what are the guys in Department 15 doing, eating those wheels for lunch?"

And so it goes. Whether it concerns abrasive and other perishable tools, or a series of operations, you know the record well. The rest is also known: a committee is formed to 'look into things' with a view toward 'reducing purchases.'

Now, the majority of readers will certainly agree that efforts to reduce costs are important, no one slights this worthy endeavor. Costs are like privet hedges, they must be kept pruned or they'll grow completely berserk. But, like a privet hedge, one shouldn't trim them just for the fun of it without plan or program and just hack around with dull pruning shears because it gives one a feeling of noble accomplishment. There is nothing noble about a hedge looking like a skinned cat which will wither and die because it's been under the clippers and tortured to death. There is nothing worthy about a cost cutting program which bores the heart out of efficiency and production. The dividing line between intelligent cost reduction analysis and haphazard slashing is so very fine, but the results can be so devastating.

Monies can be saved if the final measure of success is lowered manufacturing costs without loss of production or compromise of quality. On the other hand, costs can be slashed by spending money for the acceleration of a line which will result in an upsurge in output. There are two classic illustrations: if you merely want to save money pull the master electric switch and you'll get no electric power bill next month. Think of the savings! Gargantuan! Or you can do some additional wiring and put in electric lights in the assembly department so those poor moles won't have to sit by candlelight any more.

It's all very silly, isn't it?

And yet, how many splendid engineers are zealously dashing about, on the order of a vague inter-office memo, slashing and hacking and mutilating indiscriminately for the sake of pennies. The law of life is stern with this sort of thing!

Each operation should be approached as though it were a hungry gorilla: softly and with guarded caution. Wheel tests, tooling set-ups, automatic controls, feeding devices, automatic sizing, these are but a few of the areas to be investigated for cost cutting —a cost cutting that's not based on saving pennies to be wasted later for the repair of the damage—but cost cutting rooted in one basic thought: how much more production will accrue as a result of careful analysis? An analysis which may bring about savings in time, labor or even supplies.

So, if we're trimming the privet hedge, fellows, get a pair of electric shears instead of the dull hand clippers and save yourself a lot of time.

Wm. J. Schleicher

Editor

CARBORUNDUM® INTRODUCES:

Maximum Automation Potential

newest concept in Abrasive Technology

predicts metal removal savings with abrasive belts before capital investment

M-A-P is a *new* industrial forecast method. It is designed for automation-minded manufacturers whose production operations include heavy stock removal, finishing or semi-finishing of component parts. M-A-P predicts operating-cost savings and production increases resulting from the engineered application of the correct machine and abrasive belts—in advance of any investment in material or equipment.

M-A-P is actually the application of science to metal removal—economic science and abrasive science combined to take the guesswork out of grinding. M-A-P formulas were developed by The Carborundum Company's Coated Abrasive Engineers from a study of all standards and factors entering into abrasive belt grinding operations. M-A-P is based on the accumulated knowledge of Carborundum's years of coated abrasive manufacturing experience and the abrasive machinery know-how of its Curtis Machine Division.

Maximum Automation Potential predictions are now available to you as a standard engineering service of The Carborundum Company's Coated Abrasives Division. To get an M-A-P study on one of your present or planned metal removal operations, you need only supply a few basic production facts. Carborundum engineers do the rest—M-A-P formulas are applied specifically to your operation—*an M-A-P Recommendation is then mailed back to you.* Now, with M-A-P you can *predict and compare* return on investment—without obligation.

For further information, write to The Carborundum Company, Dept. 35, M-A-P, Senior Coated Abrasives Engineer. Ask for the M-A-P Brochure which explains this new engineering service to industry in detail.

The **CARBORUNDUM** *Company*

COATED ABRASIVES DIVISION

Niagara Falls, New York

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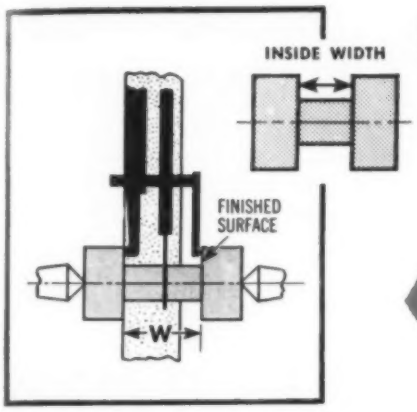

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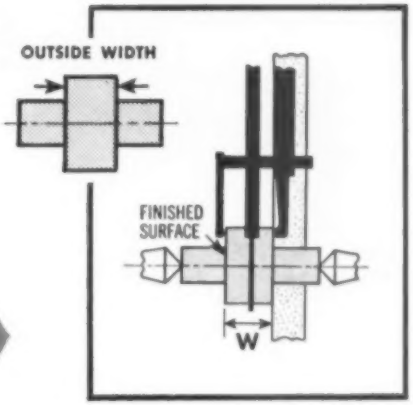

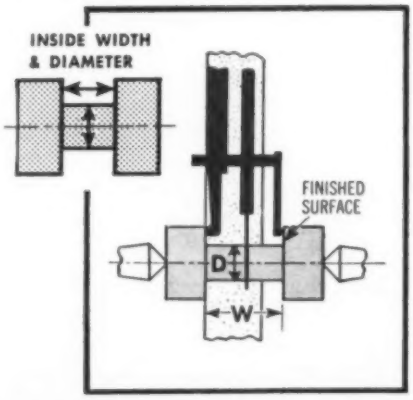

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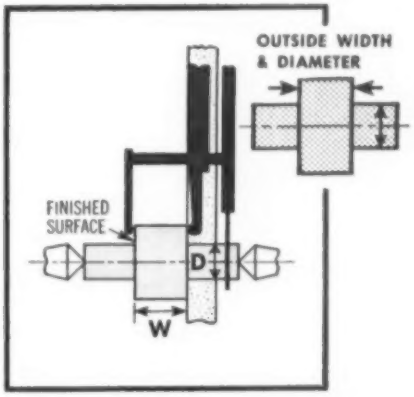

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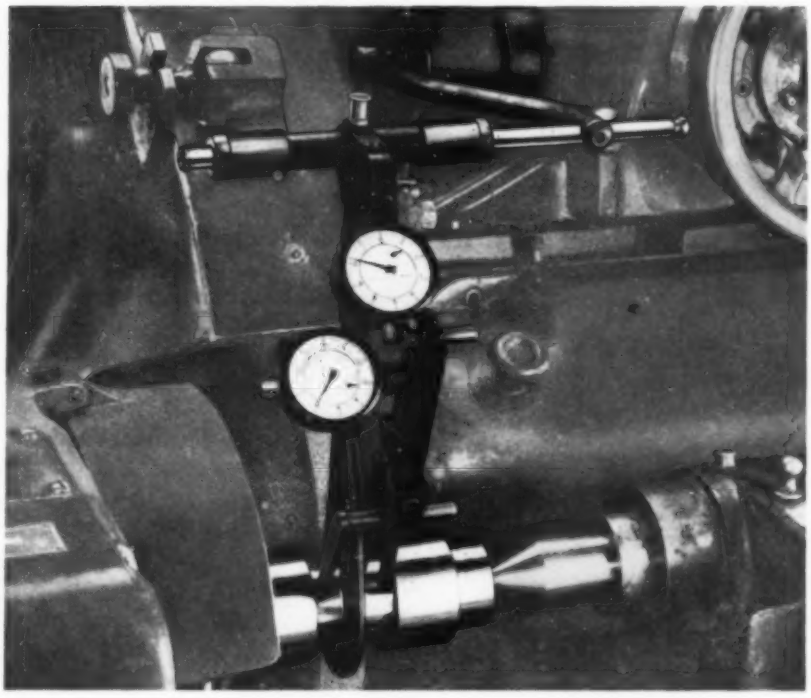

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Grinding and Finishing

MARCH 1957

When and How You Can Use

Crush Form Grinding

By **Vern Childers**
Abrasive Engineer
The Do-All Company
Des Plaines, Illinois

• In crush forming, the profile desired on the workpiece is ground or machined onto the surface of a metal roll, usually three to six inches in diameter and slightly wider than the face of the grinding wheel. This roll is then rigidly mounted on a fixture so that its shaft is in true parallel to the spindle of the grinding wheel. Wheel and roll are brought into contact with both members at rest, and after pre-loading this contact, the drive for either the wheel or the formed roll is engaged. Increment down feed is then used until the complete form is reproduced in the wheel.

How to form the wheel

There are five simple steps to crush forming a wheel:

1. Wheel and roll are brought into contact with both at rest. Bring them into contact by hand, gently.

2. Preload by bringing the wheel down four or five thousandths more to create enough pressure for the forming action and to prevent slippage which would put a flat spot on the roll.

3. Follow the wheel into the form fast enough to prevent slippage and slowly enough to avoid overloading. After a few experiences, most operators can tell what is going on by "feel" just as in operating a drill press or other hand fed machines.

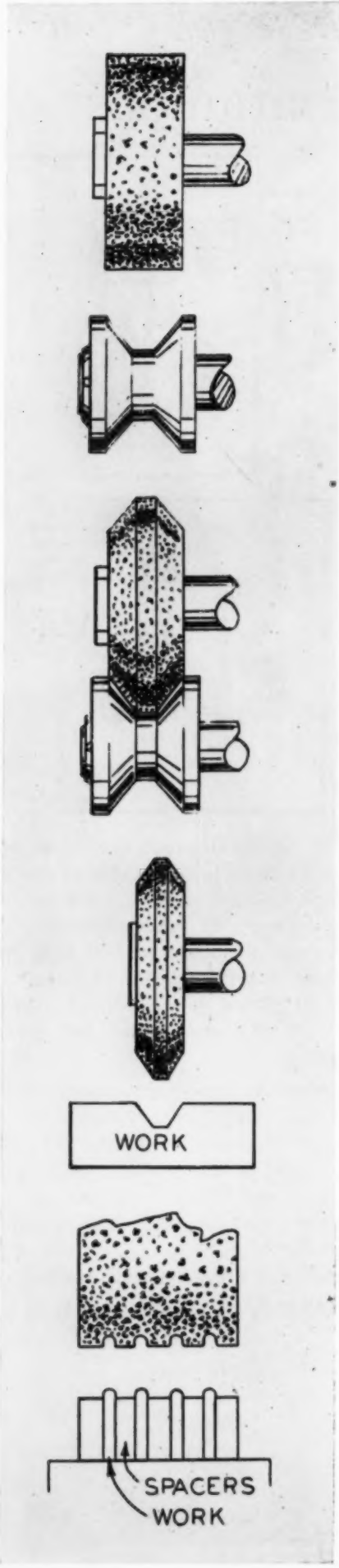
4. Keep the grinding wheel rotating slowly, usually 250-300 surface feet a minute.

5. Don't let the wheel "roll out" at the end of the cycle. Bring it down to the full depth of the form plus 2 or 3 thousandths and back it out without letting it stay in position until it rolls free.

Forming wheels

Crush forming has found applications in nearly all types of grinding, particularly in surface grinding, cylindrical, centerless, and thread grinding.

Crush rolls for high production are usually high speed steel, although for short runs and for ex-



CRUSH FORM GRINDING is accomplished by: (1) making a metal roll of the desired contour; (2) using that roll under suitable pressure to form the face of the grinding wheel; (3) using the formed grinding wheel to impart the shape to the work. In high production of small parts, several pieces of work may be ground simultaneously as shown.

perimental work they may be made of softer material, such as common gray iron.

One of the more interesting applications of crush forming occurs in the experimental development of cutting tools, where it is desired to produce a test batch of tools of a similar shape economically. In this instance, a crush roll is formed of gray iron or other inexpensive and easily worked metal, so that it may be used to form and dress the grinding wheel for a limited number of passes sufficient for the short run operation.

It is essential that crushing rolls have a very accurately ground bore to fit the shaft of the crush form dresser, and an accurate locating face ground square to the bore so that the wheel may be removed for reconditioning and accurately returned to the same position relative to the grinding wheel.

Inasmuch as the crushing or crush dressing of the grinding wheel must be repeated from time to time, it is natural that some wear should occur in the crush roll. There are several answers to this. First, where wheels are reconditioned in the tool room, a master roll is kept in the tool room, and used to redress the grinding wheel. The grinding wheel with the true form is then used to regrind the proper form in the production crush roll.

In some situations, both the master roll and the production crush roll are mounted on the surface grinder, typically one at either end of the table. With very long production runs, it usually is found practicable to have master rolls available at the work station for periodic redressing of the production crush roll, with a "grand master" roll kept in the tool room as a means of occasionally reforming the production master rolls.

Rigidity

Regardless of the application or the type of grinder, the high stresses involved in crush dressing make it necessary that extremely rigid equipment be used. Hence it is imperative that grinding wheel spindles be heavy duty and of rugged construction, and that the crush rolls be securely mounted in a heavy fixture capable of keeping the axes of roll and wheel parallel.

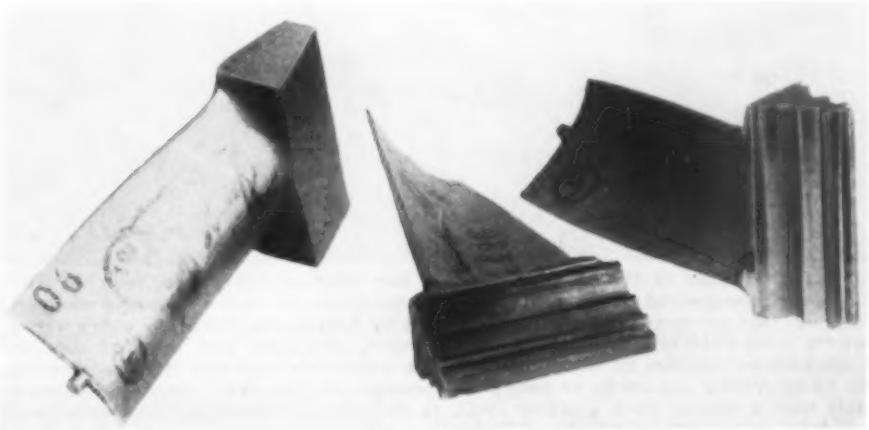
Crush form grinding is an accurate and rapid method of producing duplicate pieces by the technique of transferring a form or shape from a preformed crush roll to a grinding wheel. It has found applications in nearly all types of grinding: surface, cylindrical, centerless and thread grinding.

ARTICLE TELLS:

- √ *How to form the wheel*
- √ *Types of rolls to use*
- √ *Crushing force required*
- √ *Machine problems*
- √ *Speeds and pressures*
- √ *Selecting the proper wheel*
- √ *Economics of the process*
- √ *How to grind*

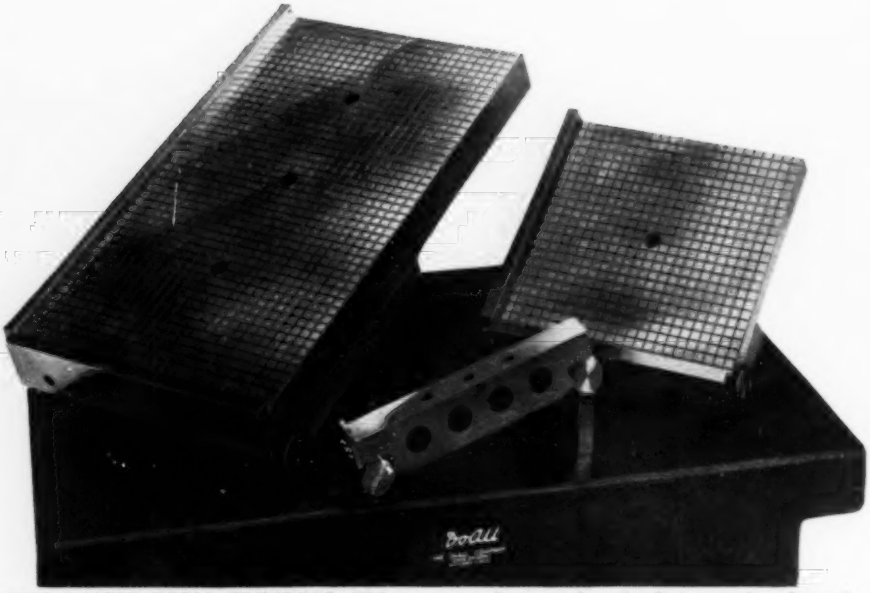
Regarding the crushing force, practice ranges from applying 100 to 500 pounds pressure per square inch of wheel face, and depends on the wheel grade and depth of form. Obviously, the same pressure applied mechanically to a surface an inch wide increases drastically when applied to a narrow surface such as the wheel contour involved in tap grinding or similar operations.

It might seem odd that anything as hard and impenetrable as a grinding wheel would yield to crushing, but this is due to the dual nature of the wheel, in that its intensely hard abrasive grains are held in a bonding agent which is a friable substance well mixed with open spaces.

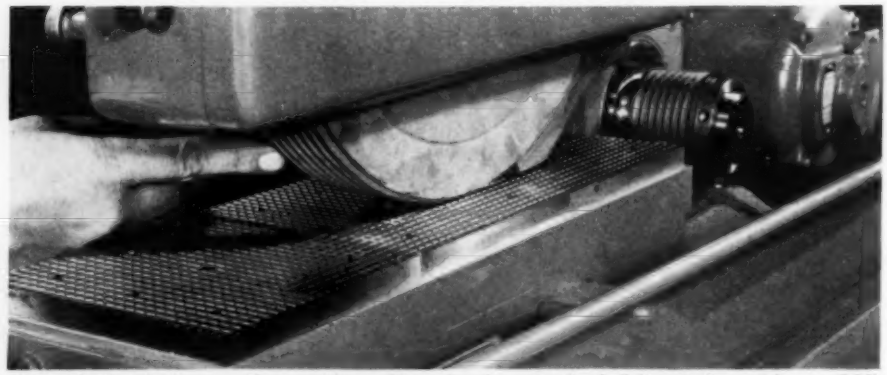


CRUSH FORM GRINDING IS NO NOVELTY. It has been used for years in tap grinding. It has been adapted to the surface grinder to produce very accurate parts like these jet buckets.

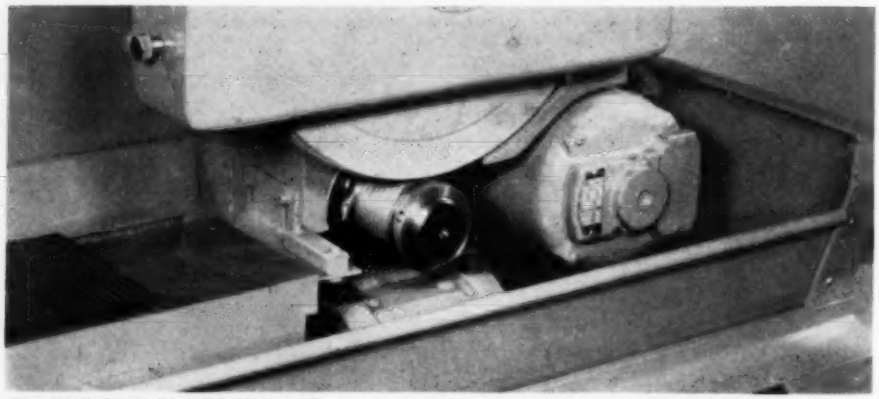
A STEEL CRUSHING ROLL, machined and accurately ground to the specific form desired. It also has a very accurately ground bore to fit the shaft of the crush form dresser, and an accurate locating face ground square to the bore so that it may be removed from the dresser and replaced in the exact location after being reconditioned in the tool room.



THIS SIMPLE FORM GRINDING JOB is a good example of what can be done by crush-forming the grinding wheel. The serrations in the face of the sine plate must be accurate and of good finish. If these serrations were milled in the plate before heat treating, there is the possibility that slight distortion during heat treating and subsequent flat surface grinding and lapping would produce a lack of uniformity in depth. Also, discoloration in heat treating would make a cleaning operation necessary.



An ideal solution to the problem. Here is the standard D8 grinder with an 18" chuck and a motorized crush form dresser. Three pieces of work are ground at once. Suitable stops are arranged on the table so that by rotating the pieces the entire waffle pattern is obtained in eight passes to its full depth. This same work could be done on a conventional machine by allowing the table to reciprocate back and forth and feeding the wheel down a few tenths at each pass. However, in this set-up, the machine has a table with a special crush grinding cycle, so that the serrations are ground to their full depth at the rate of 2½ lineal inches a minute.



ON THE SINE PLATE JOB, after a chuck load of work has been finished, the wheel is recrushed. This is done by bringing the wheel over the crush roll and bringing it down until the wheel and roll make contact. After a few revolutions, the form and sharpness of the wheel have been renewed, and it is ready for another cycle. This process of grinding and dressing continues until the crush roll has been worn down beyond tolerance. At this point it is removed, and the master crush roll installed to redress the wheel. The production roll is replaced on the shaft, and reground to proper form by the wheel, operating at normal grinding speeds of roughly 6000 SFPM, restoring the production roll to its original accuracy, feeding the wheel into the roll a few tenths at a time.

Crush Form Grinding

continued

This, in fact, gives rise to the argument that crush forming has certain superiorities over diamond point forming in that the diamond point may tend to break and dull the actual hard abrasive grains, while crushing breaks only the bonding material.

In the early days of crush forming it was considered necessary to provide gashes or dust slots in the face of the crush roll, but this is now considered unnecessary in most types of work except for very hard wheels or for forms which are unusually deep or out of balance.

Speeds and pressures

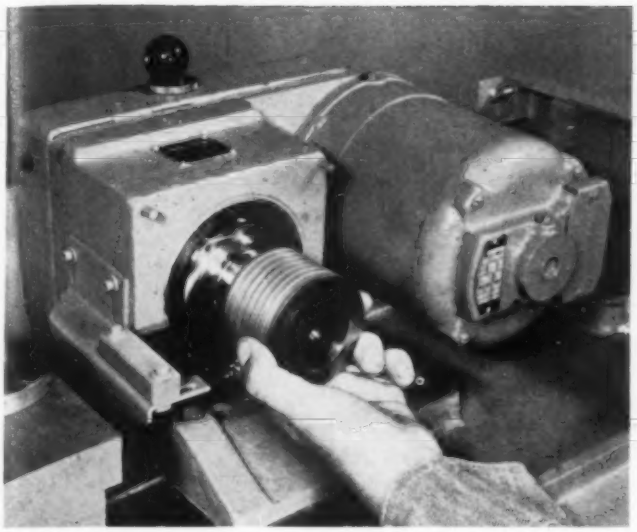
There are two commonly used methods of crush forming and dressing. In one method, the crush roll is mounted on a fixture which permits it to idle, while being "pushed" by the grinding wheel at speeds on the order of 250 to 300 surface feet per minute. In the other method, the grinding wheel is allowed to run free, being pushed by a motor driven roll.

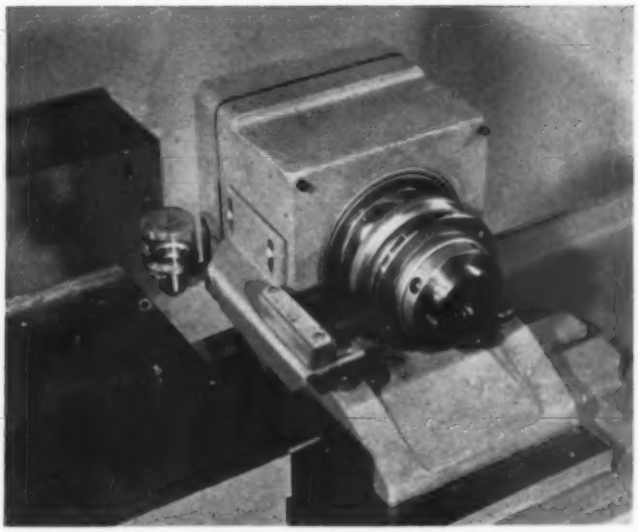
The weight of experience seems to favor the first method. In any case it is essential that the grinding wheel be provided with a special heavy duty spindle to withstand the pressures involved. In some instances, the machine must be provided with an auxiliary spindle drive to provide the required low speed.

Safety

Crush forming is no more hazardous than any other grinding operation. Grinding wheels require careful balancing, and it is recommended that they be removed from the spindle with the sleeve or adapter attached so as not to disturb the balance for future use. Normal procedures of checking the wheel for cracks should be followed.

It is agreed that it is unsafe to use wheels with lead or babbit metal bushings, as these bushings may squeeze out under pressure and, at the very least, create an egg-shaped wheel. Plastic center wheels are generally recommended.





As shown above and in the picture at the right, there are essentially two ways of crush forming or crush dressing a grinding wheel. Above is shown the motor driven crush roll. With this device, the grinding wheel is brought into position directly above the crush roll and preloaded by bringing it down four or five thousandths. The grinding wheel is set for idling, so that it runs free while the power driven crush roll revolves and pushes the grinding wheel. The photo at right above, shows an idler type dresser which can be used on the machine or in the toolroom for dressing wheels there. With this device, the operation is the same, except that the grinding wheel is powered and pushes the crush roll. In both situations, the grinding wheel is run at 250 to 300 SFPM.

Whether anti-friction or plain bearings are used, the location of the thrust-bearing is important. Unless this bearing is close to the wheel, the lengthening of the spindle as heat develops will tend to shift the wheel in relationship to the roll.

Wheel selection

Generally, only vitrified bonded wheels are used for crush forming. Organic bonded wheels are too resilient to accept this type of forming well. Oil is generally considered to be the preferred coolant-lubricant, both during crushing and subsequent use in grinding.

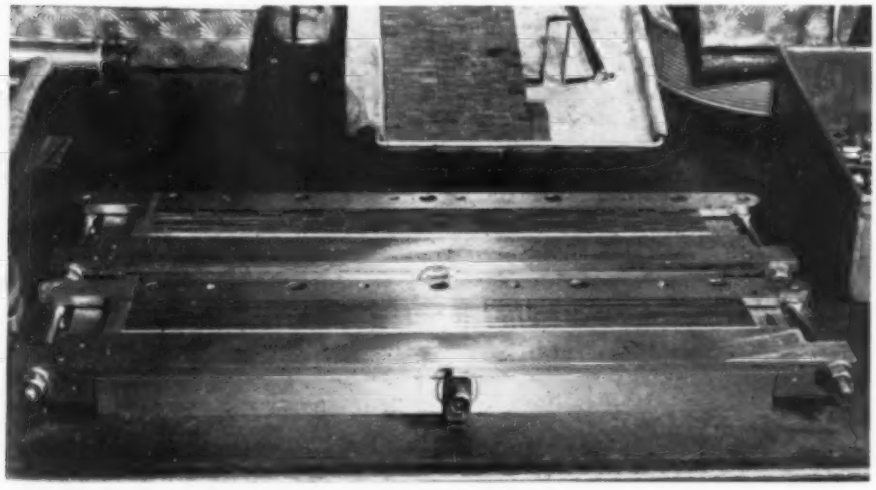
Both aluminum oxide and silicon carbide wheels are crush formed, the most common grain size ranging between 120 and 220 grit.

Basically, the grain size is determined by the smallest radius that must be formed. In preparing wheels for thread grinding, for example, where each pitch has its own tolerance, the accepted rule of thumb for grit size to produce the proper radius is to multiply the pitch of the thread by 10 to get a numerical equivalent for grit size.

Basically, crush forming and grinding is a high production procedure. Considering that crush rolls cost, depending upon machining necessary, from $100 to $350 each, you have a tooling cost which must be amortized against the production run. Thus a short run might be better served by diamond shaping, perhaps using a template in the accepted manner, inasmuch as the cost of such a template is nominal, and a short run will not require a great number of redressings of the wheel.

The repeated dressing of the wheel by the crush roll removes a minimum of material, increases wheel life, and continues to produce a wheel which will generally cut about 25 percent faster than a diamond dressed wheel.

In thread or tap grinding or similar situations, the wheel face can be crushed to form in a fraction of the time it takes to form it with a diamond, and the thread form can be produced quickly with one pass.



MANY TIMES A JOB WILL RESPOND to normal speed and fine downfeed increments at each pass, particularly where the work surface is large, as in the case of the special chuck load of small power steering vanes shown below. Preloading one chuck while the other load is being ground enabled the operator on this job to grind 312 pieces in an hour. For production work like this, the grinder should be equipped with an automatic downfeed so that the wheel automatically lowers a set amount between each reciprocation. Where dimensions are critical, a lock should be added to prevent any cross-feed movement.

Making the cuts

There are two accepted techniques of using the wheel which has been crush formed. One involves feeding down by small in-

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WHEN DRESSING THE WHEEL, it should turn slowly at about 250-300 SFPM. Because of the pressures involved in crushing the wheel, either in originally forming it or in redressing it, it is essential that a heavy duty spindle be used to provide the maximum rigidity to maintain necessary parallelism between crush roll and wheel axis at all times. Because there is sometimes a chance that slippage may occur when pushing the grinding wheel with the motorized crush roll dresser, it is generally recommended that a heavy spindle be used with the grinding wheel and then let the grinding wheel push the idler type dressing roll.

crements on each pass. Some machines are equipped with an automatic downfeed which can be preset for the required increment so that the wheel is lowered automatically after the return from each pass across the work.

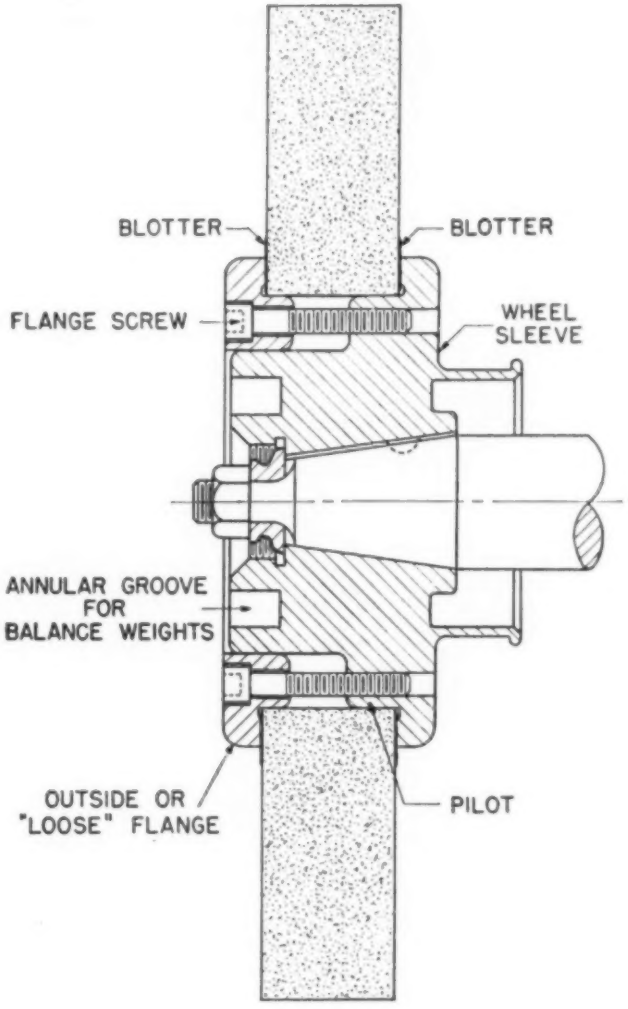
The other method involves bringing the wheel down to the level of the full cut and making a single pass across the work. This requires the use of a special slow feed crush grinding table which moves at the required rate of an inch or so a minute feeding the work into the wheel, and returns to position rapidly for transfer of work on and off the table.

Which method is used depends upon the nature of the wheel and material, but generally it may be said that work of larger area or surface is more likely to require the automatic downfeed with reciprocating table, while work such as taps or gear teeth or smaller pieces can be ground to finished dimension with one pass.

Crush forming is not usually recommended where it is necessary to hold a very sharp edge, nor can a groove or shoulder with a vertical side be readily crushed into a wheel face. • • •

How to Prevent Wheel Breakage by

Proper Mounting of Wheels



REPRESENTATIVE DESIGN of sleeve mounting for cylindrical grinder. This article covers recommended technique for mounting wheels of this type.

● More cylindrical grinding wheels are broken as a result of "sprung" flanges than from any other cause. This flange springing is due to excessive or non-uniform tightening of the flange screws during mounting, which produces uneven stress and cracks the wheel from the center hole outward. Sometimes the actual breakage doesn't occur until the wheel is brought up to speed or applied to the work, but the underlying cause has been improper mounting techniques.

Experienced machine operators develop a remarkable sense of how much wrench pull to apply, it's true, but if you go into the average grinding department you'll find that excessive tightening is prevalent. It's no good to say to an operator, "Tighten the screws just enough to keep the wheel from slipping," or "Do not tighten too much."

The best way to mount a sleeve-mounted grinding wheel is to use a torque wrench to tighten the flange screws, and to tighten them in a prescribed order around the flange. These are the recommendations of the Safety Committee of the Grinding Wheel Institute.

Recommendations by the Grinding Wheel Institute apply to sleeve-mounted wheels thirty inches in diameter and under, up to four inches thick and with holes ten and twelve inches in diameter. They apply on plain cylindrical, crankshaft and cam grinding machines made by Brown & Sharpe, Cincinnati Grinders, Landis Tool, and Norton com-

continued

panies. They're also a guide for other makes and types of machines within the same size range, where the basic sleeve design is similar. The full procedure has been published by the Institute in the form of a booklet, "Mounting Technique for Wheel Sleeves on Cylindrical Grinding Machines." Here's a summary of the booklet's recommendations.

Mounting Procedures

Be sure to use new clean blotters each time a wheel is mounted. Tighten the flange screws up to 15 foot pounds of torque, using the following procedure: Tighten one screw lightly and then go to the diametrically opposite screw and tighten it a similar amount. Next tighten the screws midway between and continue this criss-cross pattern until all screws have been tightened lightly. (Don't first tighten one screw up the full 15 foot pounds and then go to the adjoining screw and tighten it up to 15 foot pounds. This is likely to damage the wheel because the flange won't be drawn down evenly against the wheel.)

Next tighten each screw to 15 foot pounds, following the same order or sequence as before. It may be necessary to repeat the final tightening a second or third time to insure that all screws are uniformly tightened to 15 foot pounds torque.

After a period of eight to sixteen hours grinding time, the screws should be checked again and re-tightened. This is necessary because of normal compression of blotters which occurs. Grinding Wheel Institute research showed that blotter compression causes in some instances a loss in the original 15 foot pounds of torque that had been applied in mounting the wheel, which can be taken care of by checking and re-tightening after use. Follow the same criss-cross procedure described in the preceding paragraph. It isn't necessary to remove the wheel and wheel sleeve from the machine for this supplementary tightening.

Limitations of the Research

No research on mounting techniques was done for wheels larger than 30 inches in diameter or four inches in width, for wheels used in crush-dressing jobs, or for centerless grinding wheels. In these cases, the following procedures which have been outlined should be helpful, however, in determining the proper flange pressures:

1. On jobs using wheels larger than 30 inches in diameter or 4 inches in width and where the stock removal is high, it may be necessary to tighten the flange screws to a torque higher than 15 foot pounds to prevent slippage of the wheel between the flanges. Any increase, however, should be made in small increments until the minimum is found where slippage is overcome. At this point flanges should be checked to make sure they

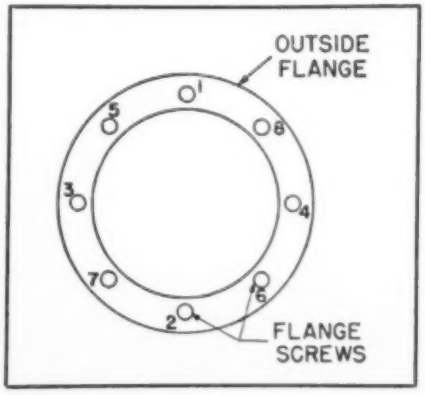
PRACTICING WHAT THEY PREACH—Grinder operators at P. A. Sturtevant Company, Elmhurst, Illinois, use their own firm's brand of torque wrenches to tighten screws uniformly on sleeve mounted wheels. Grinding Wheel Institute recommends use of torque wrench to achieve 15 foot pounds torque on screws, except for centerless, crush-dressed, or extra large wheels, which may require higher torques.

Research by the Grinding Wheel Institute Shows:

- ✓ *More sleeve-mounted wheels are broken from sprung flanges than from any other cause*
- ✓ *flange springing results from excessive tightening of mounting screws*
- ✓ *15 foot-pounds torque should be applied to mounting*
- ✓ *screws for most types of machines*

aren't sprung. If springing is taking place the only safe remedy is to procure more rigid flanges.

2. Wheels used in crush dressing operations may also require tightening of flange screws in excess of 15 foot pounds to prevent slippage or shifting of the wheel due to radial pressure during the crushing. Here again it may be necessary to get heavier flanges if the required flange pressures can't be obtained without springing.
3. Centerless grinding often involves severe pressures and may require more tightening than the recommended 15 foot pounds. However, flanges on centerless grinders are usually designed to resist tightening pressures up to 40 foot pounds or higher.



ORDER OF TIGHTENING for sleeve-type mounting of the conventional 8-screw design.

The recommended 15 foot pounds tightening torque, it should be firmly remembered, *does not apply to any other type of mounting than that illustrated at the beginning of this article*. For instance, wheel mountings of any type which employ a single central nut to tighten the flange usually require much higher torque readings to produce the same effective flange pressure against the wheel.

Use of Torque Wrench

The preceding recommendations mention torque in "foot pounds." The surest way to control the amount of torque applied to the flange screws is by means of a torque wrench.

Use of the torque wrench is considered a standard method of tightening fasteners to uniform stress loads. It is important to follow the manufacturer's instructions as to the proper use of this tool.

How Screw Thread Condition Affects Net Torque

When tightening a screw or bolt it is difficult to determine what part of the wrench pull is being used to apply tension in the bolt and how much is being dissipated in thread friction and other friction losses. It is recognized that the condition of screw threads can affect the reading with a torque wrench as much as 25%. In the Grinding Wheel Institute tests, the condition of the screw threads was maintained so that the screws could be "seated" by finger pressure, without any measurable torque. This helped insure uniform tightening of the screws.

If a measurable amount of torque is required to "seat" the screws because of the fit of the threads, it's a fairly simple matter to compensate for it by adding the measured amount to the desired final torque figure. For example, if the required torque for each screw is 15 foot pounds and if 5 foot pounds is required to turn the screw until it's seated, the gross reading on the torque meter should be 20 foot pounds when final tightening takes place. This results, of course, in a net effective torque of 15 foot pounds.

It's a much easier proposition to maintain the screw threads and holes so the screws run freely in the holes.

Results of Excessive Tightening

Distortion of a flange caused by excessive tightening of the screws results in an inefficient and potentially dangerous wheel mount.

A distorted flange is an ineffective flange, because the flange pressure is not uniform over the proper contact or gripping area. The distorted flange is unsafe because stress concentrations it produces in the wheel can result in wheel breakage.

• • •

RE-TIGHTENING THE SCREWS with torque wrench after they're used for 8-16 hours is another recommended standard procedure, because of blotter compression which takes place during grinding. Wheel needn't be taken off machine to do this.

Surface Grinding

HORIZONTAL SPINDLE—RECIPROCATING TABLE

IN THIS SERIES—

1. ADVANTAGES—APPLICATIONS—ECONOMICS
2. FUNDAMENTALS AND METHODS
3. MACHINES, ATTACHMENTS, SPECIAL DEVICES
4. WHEEL SELECTION AND WHEEL FORMING
5. CAUSES OF FAULTY SURFACE GRINDING AND CURES

Part 1: Advantages, Applications, Economics

Prepared by the editorial staff of GRINDING and FINISHING and Edmund Mottershead of Mottershead Associates.

● One of the major difficulties in writing about surface grinding is the fact that, as the engineer of one company put it: "Everybody knows all about it . . . they think. The process is so well known that many people don't realize its full potential, now that modern wheel design together with special chucks, controls, and other devices have made the possible applications of this type of grinding very much greater than they used to be."

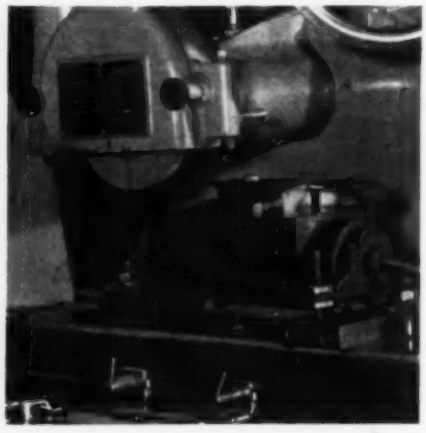
In the competitive battle between metal working machines which use metal cutting tools and grinding machines, the advocates of grinding say modestly that the grinding wheel will do everything a metal tool will do, do it better and often faster, and then go on from there to romp through metals and non-metals from which metal tools would flinch in dismay. In terms of accuracy of dimension and nicety of surface, any effort of metal tools to compete is considered grotesque.

While there are surface grinders having various combinations of vertical or horizontal spindles, solid or segmented wheels, reciprocating or rotary tables, or travelling wheels, this series of articles will be concerned with those having horizontal spindles and reciprocating tables. These machines, which grind with the periphery of the wheel, are probably the most numerous of surface grinders.

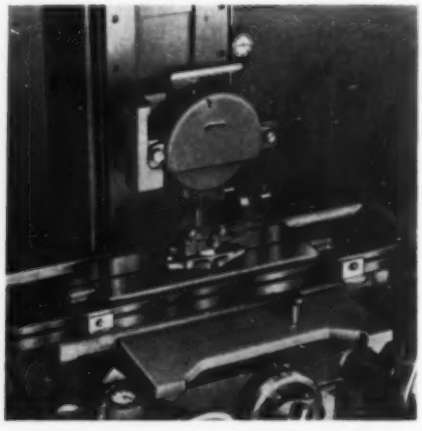
All types of plane surface grinding can be done with them, and they are at their best use on jobs requiring great accuracy and good finish with a straight scratch pattern parallel to the traverse motion. Slots and grooves in planer tables are common jobs for these machines, as the scratch pattern is excellent for slide bearings.

Other jobs often produced on these surface grinders are beds of planers, milling machines, lathes, grinders, and other massive machine tool parts which need an accurate and smooth job on ways without the expense of scraping. Tolerances of .0002-inch for dimension, straightness, and parallel, is well within the range of these machines for production work. The grinding action is generally cool. They can handle large, unbroken surfaces readily, and with a broad wheel face they can span holes of reasonable dimensions. Faster work,

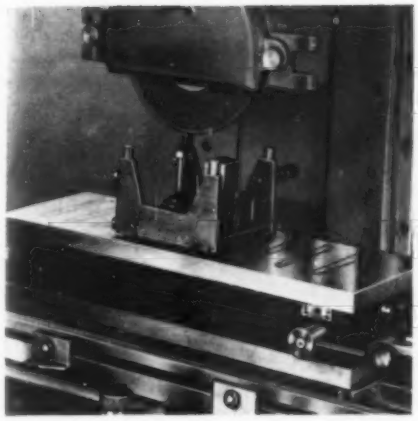
Clyde Tool & Die Company, Clyde, Ohio, using Sterling wheel and magnetic chuck for die surfacing job.



This set-up for grinding motor laminations uses special fixture for holding work. Coolant flows through the wheel.

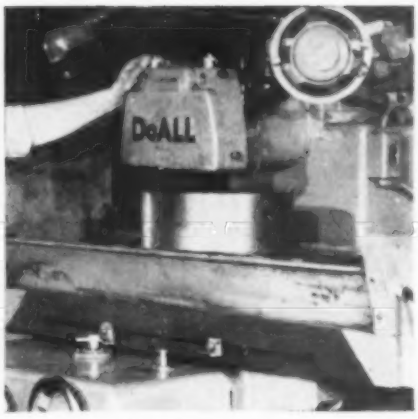


This set-up for grinding snap gages uses dial indicators and measuring rods as continuous quality control.



Hardened steel base pads on drill jig are positioned for surface grinding and held on magnetic chuck.

Surface grinding the flat sides of these milling cutters is accomplished with coolant through the wheel to avoid burning the metal.



Conventional surface grinding of plastics mold die provides true flat surfaces, accurate dimensions.

of course, can be done on large surfaces by other types of surface grinders.

Metal Removal

It must be borne in mind that the grinding wheel is not a "rubbing" tool—it is just as much a cutting tool as a lathe bit, and the minute chip removed by the grinding point in the wheel is very similar in shape and character to the large chip removed by the metal tool.

However, while the metal cutting tool must dig deeply in order to have its side surfaces engaged in the work—so as not to dull the point and in order to penetrate below any surface scale—the abrasive points in the grinding wheel pay no attention to scale or other surface difficulties in the material being ground, and quickly get down to clean metal.

The result is that grinding with the horizontal surface grinder—and with other grinding machines—very quickly reaches desired dimensions at a level much closer to the surface than is possible with other machine tools. Where casting design specifies an oversize piece to allow for the removal of a coarse fraction of an inch by milling or lathe operations, design for grinding can specify allowances of only a few thousandths, just enough for the wheel to reach clean metal below the scale. Result: savings in metal, in weight of pieces to be handled, in tonnages of scrap metal produced at a dead loss.

The speed of removal of the undesired metal, of course, is much faster with surface grinding, and production in terms of pieces per hour or square inches of surface finished is substantially greater than that obtained by other methods.

Set-Up Time

Surface grinding, of course, is the set-up man's dreams, just as centerless grinding has come to take jobs away from metal turning tools and from center-type grinding because the work can simply be thrown into a hopper or laid on a conveyor and given no further attention as to positioning.

The magnetic chuck has done the same for surface grinding. Parts designed for milling or planing operations are designed to make provision for being clamped tightly to the machine table, as the pressure between work and tool is usually very great, for the cutting action involves great forces produced by the tool.

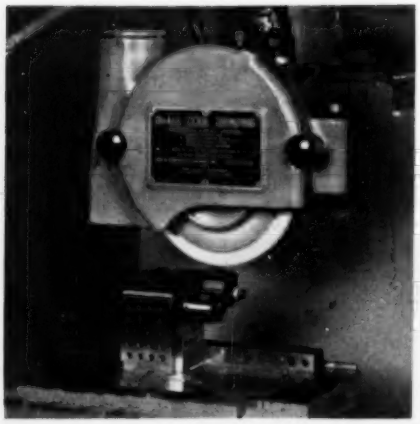
Parts designed to be surface ground, on the other hand, are usually simply laid on the magnetic chuck. Magnetic flux and friction hold the piece securely. Non-magnetic pieces, of course, can readily be held in place on the magnetic

Under the old method of producing cast iron housings, the ways on one job similar to that shown above were hand scraped, requiring the services of two men and the use of a crane to handle each piece. Scraping time per housing was approximately 8 hours. Precision grinding of the ways to remove .010" of material effected a grinding time per piece of 2½ hours. Savings per piece of 5½ hours of labor on a total run of 266 housings amounted to 1463 hours. Machine used was 18" x 16" x 84" surface grinder. With reference to using horizontal or vertical spindle grinding machines, one manufacturer has found that on large flat work, where a substantial amount of material must be removed, they could remove more cubic inches of material per minute on a horizontal spindle machine than with a vertical segment type wheel grinder. This is due to the fact that when the large segmental wheel passes over a large area, the chips which it removes are sometimes unable to clear the segments, and thus a burnishing action is accomplished, rather than a clean cutting action.

Surface Grinding

PROBLEM:

The part to be machined was a cavity insert for multiple molding die used in producing Bakelite and plastic TV tube sockets. The cavity insert supports were ground from a solid heat-treated high speed steel blank. ⅝ths of the material was removed in form grinding, and extremely close tolerances were maintained throughout. Dry grinding techniques with a standard indexing fixture resulted in burning of the material, wearing of the wheel to an unwanted taper, and warping of the slender mandrel supporting the work due to the heat generated by grinding.



SOLUTION:

Milwaukee Precision Grinding Corp., Milwaukee, Wisconsin, solved this one with "cool grinding"—with coolant applied through the wheel, thus providing coolant and retaining the visibility essential to precision form grinding. Heating and burning was eliminated. Mandrel warping was also eliminated. The remaining problem was wheel wear. Experimentally stepping up the hardness of the wheels, the wheels used were changed from the original 80-H to 180-K, an extremely hard and fine grit wheel. This wheel, according to Mr. Alfred Axt, President of Milwaukee Precision, was practically wearless, but after removing large quantities of material, it would tend to glaze over. Again, on an experimental basis, a teaspoon of the common detergent, "ALL," was added to the coolant, using a wheel that was completely glazed over. In a short time, this wheel was restored to usefulness and cut very well. Mr. Axt points out that he does not recommend the use of detergent in normal work, as it is messy and leaves an unpleasant feel to the metal, but that it was very helpful in this case. The radius being ground was a full 180 degrees, so that no touch-up of a wheel was possible. When it glazed or wore down, a full ¼ inch of material had to be removed with complete dressing and forming of the wheel, an operation requiring roughly 1½ hours, hence the importance of getting as much production as possible from each wheel dressing. Wheel life with cool grinding and occasional use of detergent on glazed wheels was stepped up roughly 400 per cent.

chuck by placing them between blocks or rings or chocks of steel. The pressure of the grinding wheel is so light that this merely nominal "holding" of the work to the table is sufficient to provide conditions under which the grinding wheel can produce work to the finest tolerances as to dimension, finish and flatness.

One thing should be said of magnetic chucks: keep them clean. The manufacturers of these devices provide ample information as to their repair and maintenance, and the shop electrician is the man to fix them, the few times something may go wrong. However, it is a fundamental, sometimes overlooked in the haste of high production, that the magnetic chuck must be kept clean, smooth, and accurate as to surface. When the chuck is off the machine, it should be cleaned and greased, and the surface protected. With some lubricants, there is some danger that the swarf will form ridges and harden across the face of the chuck, leading to various electrical ills as well as irregularities of surface.

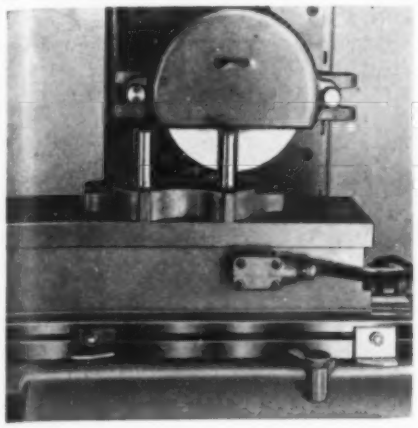
This grinding swarf should be wiped off thoroughly between chuck loadings. A piece of old leather belting is good for this task —also the flat of your hand.

Designing Parts for Grinding

It is of course desirable to analyze parts both from the standpoint of operations as well as product performance, and design parts with grinding in mind.

Minor changes in the design of surface areas, elimination of unnecessary obstructions, and reduction in stock removal requirements often make possible substantial savings and improved quality and performance, by designing the parts specifically for surface grinding production.

Thin-walled pieces are easily ground without warpage or deflection under a heavy cut. Hard spots and scale are no problem either.



Surface grinding with this set-up permits grinding of blanking die without removing inserts from die-set.

Magnetic chuck makes possible production surface grinding of many small parts such as these, which are ground on top and bottom.

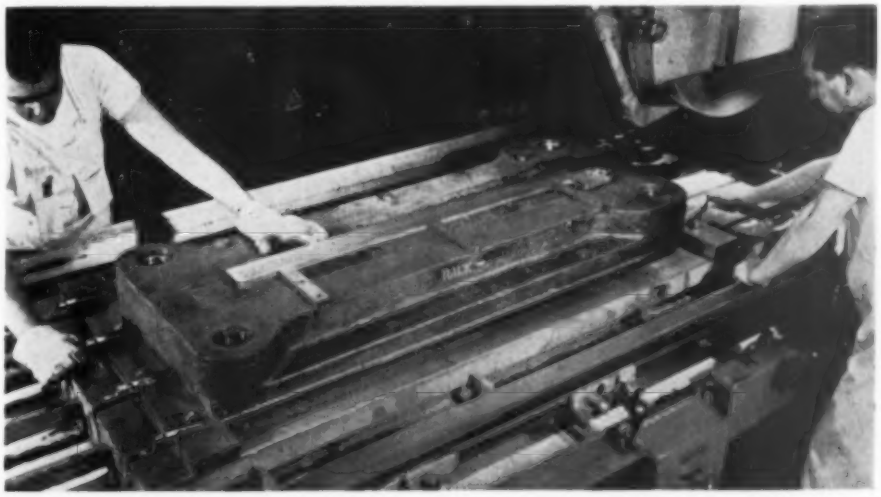
Using a precision Sine chuck makes it relatively simple to put an accurate angle cut on a piece with surface grinder.

There are three prime requirements for the design most suitable for grinding: 1. The amount of metal to be removed should be held to a minimum; this not only saves metal, but it also reduces work time. 2. The areas of plane surfaces should be kept as small as possible. 3. Surfaces to be finished must be made accessible to the grinding wheel.

Saving material: simply because they came up through the ranks from apprentice to machinist to toolmaker, or through some other experience which gave them a background in metal cutting tools, too many designers have typed grinding only as a finishing operation, or as a method of handling only the "fussy" jobs. Metal cutting tools not only create waste because they require heavy cuts; the heavy cuts are also very apt to create internal strains which cause warping of the piece. Cutting down the finish allowance in designing the piece for grinding not only saves metal, it also provides for producing the piece under conditions which eliminate strains, warping, and other problems.

Reducing areas to be ground: In the surface grinding of flat pieces, there are frequently broad areas of the work in contact with the wheel. While the horizontal spindle machines cut only with the periphery of the wheel, and it is possible to get adequate coolant at the point of contact, it is still advantageous to redesign plane surfaces to make them as small as possible and speed the entire operation. The most common approach to this is, for example, found in designing base plates or pads which, under metal cutting practice using planer production, would have a large flat surface to be machined. Under good grinding design, the pieces have the bottom surface skeletonized, so that only the areas around bolt holes and directly supporting the piece must have their surface finished. The pads are as strong as ever, and they are lighter, cheaper because of less metal, and cheaper because of faster grinding production. One interesting aspect of design such as this is that the miller or planer would require the same production time to finish either the entire flat surface or the redesigned and skeletonized flat surface; whereas the grinder production time is measured directly in terms of cubic inches of metal removed.

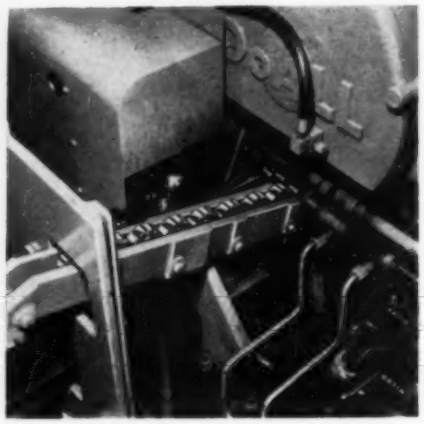
Accessibility: Portions of many pieces have to be machined simply



Speed and precision may be obtained on large work with surface grinding, as well as on small pieces. In the job illustrated above, a male blanking die of high carbon, high chrome Ontario steel was precision ground on a surface grinder. Accuracy was maintained to .0003" as compared to .006" which was the closest tolerance obtainable on the previous set-up. Floor to floor time for grinding the die was reduced from 3 hours to 1½ hours. Metal working industries in increasing numbers are turning to surface grinding as a means of precision finishing on both high production runs and heavy pieces. Large and irregularly-shaped, heavy pieces require the use of a heavy duty surface grinder capable of maintaining extreme rigidity and true relationship of table, work, wheel spindle and wheel surface during the grinding process.

Surface Grinding

Grinding slots in small rotors is done with continuous feed attachment plus automatic indexing device which rotates each piece properly for next pass. Production on this job is about 80-90 pieces (1,000 slots) an hour.



Coolant through the wheel increases production and steps up quality on this operation of grinding shave knives for broaching. Coolant insures that there will be no heat damage to tooth of knives.

Dicing of germanium wafers is done by spindle shaft extension with 12-2" diameter diamond saws spaced .250" apart. Blanks, .250" square, are produced in two passes. Wafers are cemented to ceramic plates, and one pass is made, after which plates are rotated 90 degrees for the second pass.

because they can't be reached because of some obstacle or interference between the cutting edge of the wheel and the surface to be finished. Thus, simple redesign of the part may not only improve it functionally, but may cut its production cost in half by making it possible to substitute a grinding operation for, say, filing or milling.

Accuracy and Finish

Various grinding techniques have been perfected to produce dimensional accuracy and finish to tolerances which would have been simply incredible a few years ago. These tolerances are now considered commonplace in the industry, and are specified where necessary. However, it should be noted that the cost of a grinding operation increases sharply with the finess of finish and closeness of tolerance required, so that it is extremely uneconomic to specify finer tolerances or finish than are required functionally on a piece. There is always the temptation to put a fine finish in a piece simply because you are already so close to achieving it, but this can lead to dangerous cost increases.

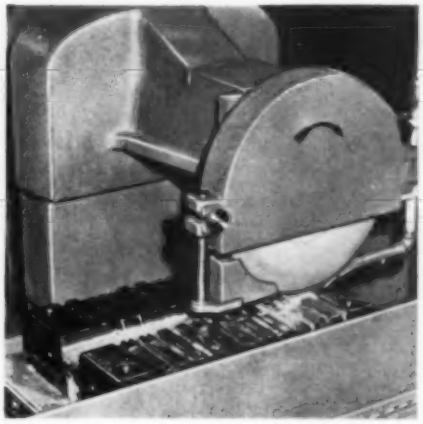
Dimensional control in grind has reached a point where tolerances can be controlled to within .0001 inch on production runs with automatic equipment, and parts produced on magnetic chucks can be held, as to face run-out or squareness in relation to bore or OD to half a tenthousandth. In general production, a finish of ten microinches is common. However, we must reiterate, the object of the process is maximum production at lowest cost, and tolerances on finish or dimension should be no closer than actual function requires.

Sundstrand Machine Tool Company reports that grinding time on small parts has been cut almost in half by using a large surface grinder capable of handling a greater load and with a greater grinding area. Gear parts shown above were formerly ground 6-up. Now they grind 28 pieces in one load. Tolerances within a few tenths are obtained.

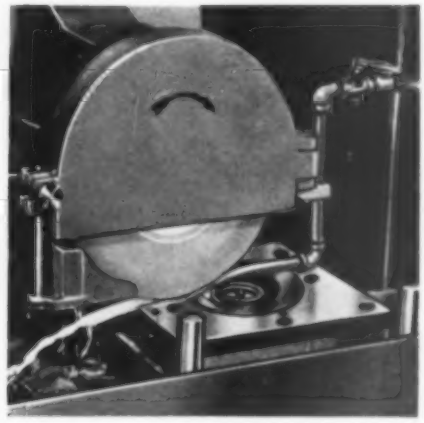
Versatility

The range and versatility of surface grinding is constantly expanding. New attachments provide automatic controls, high speed spindles make it possible to grind hard-to-reach surfaces with small wheels.

Slicing germanium wafers is done with diamond wheel .015" thick in one pass with this modified surface grinder.



Wet grinding of die-casting cavity die is carried out with coolant applied at point of contact between wheel and work.



Another wet grinding set-up, this one shows wet grinding of surface of a trim die for die-casting operation.

Cylindrical grinding and indexing attachments provide for grinding tapers, squares, angular, and multi-surface forms.

Surface grinding has also progressed far beyond being a toolroom operation, or one merely designed to handle small parts, although countless tasks of this nature are performed on these machines.

Surface grinding as a method of machining heavy parts has also gained in prominence in recent years. Large, high-powered, precision surface grinders can now handle pieces of large size and immense weight running into several tons. The strength and rigidity of equipment has been increased to handle these huge loads. Such machines compare in size to the high production bed-type milling machines and openside planers.

Automation has also come to the surface grinder by way of hopper feeds to deliver the parts to the grinding point, indexing attachments to move the parts into position, automatic down feeds, special fast traverses for the tables or traverses with interrupted cycles which permit step and repeat operations, and other adaptations which make the process not only competitive but a leader in high production close tolerance work.

Cost Economics

The relationship between grinding and other machining is really complementary rather than competitive. There are types of work best suited for each. The jobs which require heavy metal removal are certainly machine tool jobs. Those requiring dimensional accuracy and perfection of finish are usually grinding jobs. True, there is some overlap, and the design of the part may swing one way or another to establish the job in one class or the other.

Factors to consider in evaluating potential costs on a job include the matter of fineness of finish, dimensional tolerances, set-up time, actual cutting time, loading and unloading time as a part of over-all floor-to-floor time, light cuts or plunge cuts, skeletonizing the part, internal strains, the possibility of burns, and similar items all of which have a bearing on the ultimate cost of the job. Because of the equipment available in the shop, cost comparisons are usually more common between types of grinding rather than between grinding and machining.

The problems of tool cost must be studied while including not only the greater wear of the grinding wheel, buts its greater productivity in terms of pieces as compared to its original cost. Metal cutting tools must also include the cost of re-grinding and sharpening as a proper part of their tool cost.

• • •

Part 2 will appear in the April issue.

coming in G & F

In preparation for readers of GRINDING and FINISHING are articles on . . .

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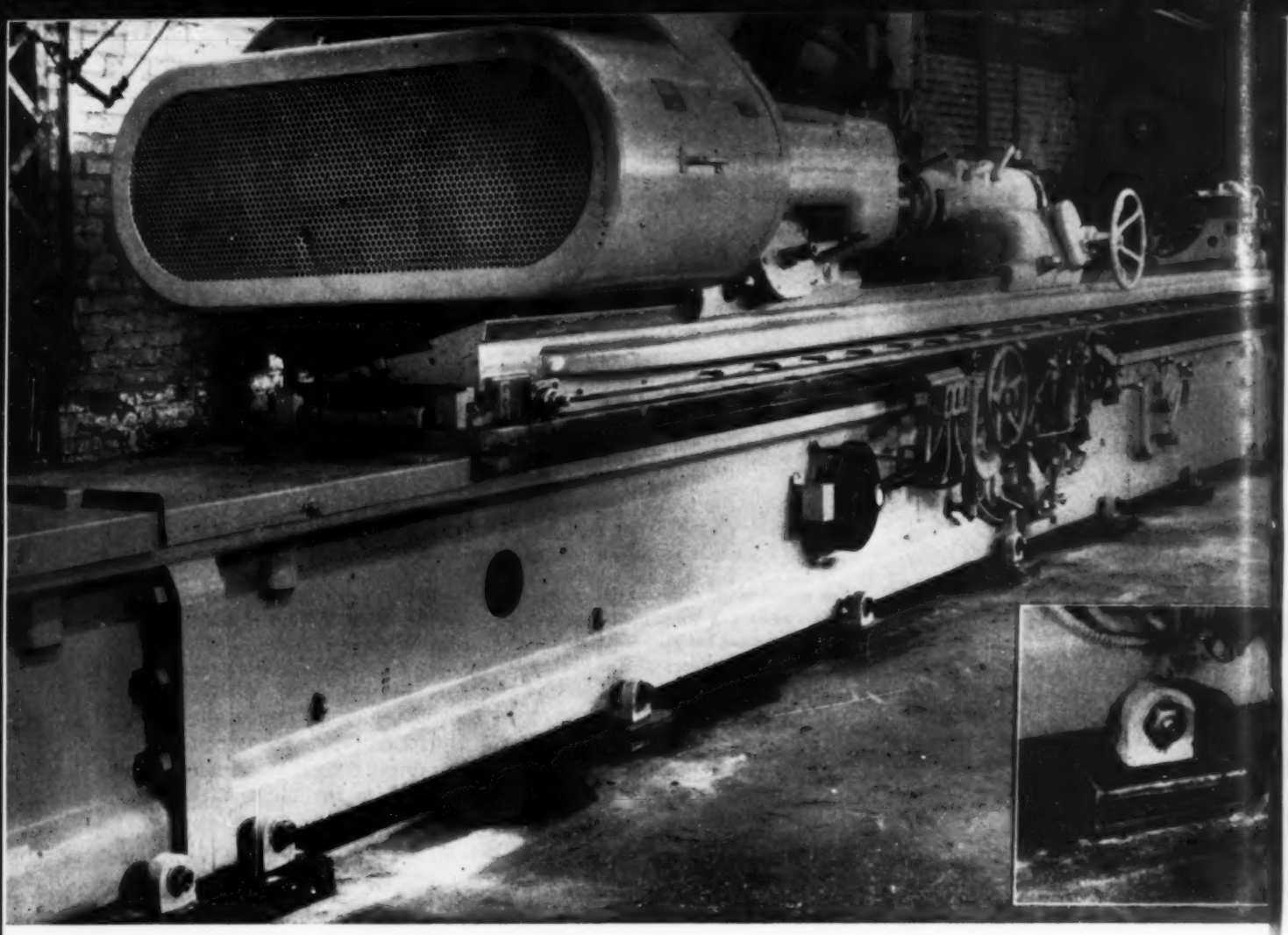

NORTON TYPE D plain cylindrical grinder installed to maintain accuracy of level to .0005". Vibration from mainline railroad 40 feet from grinder installation was absorbed by patented mounts, eliminating chatter marks from work produced by machine. Inset: one of series of 26 "Air-Loc" mounts and steel plates, all 8" x 12".

How to Install a 45 – Ton Grinder Within 40 Feet of a Railroad !

● When planning the installation of a new 45-ton cylindrical grinder, E. D. Jones & Sons Co. of Pittsfield, Mass. faced an unusual problem. Within 40 feet of the machine installation site in the plant, a mainline railroad promised to give plenty of vibration trouble which would cause chatter marks on the finished work. And the grinder had to be installed to maintain accuracy of level to .0005-inch.

Precision Installation Made

Because of the gripping power of the mounts selected, no foundation hold-down bolts were used. The bed was installed on a series of 26 "Air-Loc" mounts used in conjunction with steel plates. Each of the 26 mounts was installed with 2 "Air-Loc" mounts sandwiched between 3 steel plates, using 8" x 12" mounts and steel plates of the same size.

A tapered sliding wedge was laid flat on the top steel plate to fit the bevel on the foundation of the grinder. Jack screws were used for final adjustments in leveling bed to .0005". Table, head stock and foot stock were then installed and a 3-ton work load was placed on work centers. The installation was allowed to "settle" for about 36 hours, and was checked for level.

Because of the accuracy required on the work being done by the grinder, periodic checks were made to assure accuracy of level. 30 days after the original installation, the bed was checked for level and was found to require no adjustment. After another 60 days of operation, a similar check showed the installation to be well within the .0005" tolerance originally required. In addition, the problem of vibration from passing trains was solved, due to the ability of the patented "Air-Loc" mounts to absorb and cushion vibration. The vinyl, sisal and cork mounts are made by Clark, Cutler, McDermott Co., Franklin, Mass.

• • •

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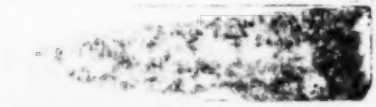
WAS IT DROPPED? Or did somebody just leave it there with the wheel face against the floor where it can get nicked and cracked? Treat grinding wheels as you would any other high quality tool. A respect for the tools is the first step towards safe and efficient operation on a grinding job.

GRINDING Safely

By **Edmund Mottershead,** President
Mottershead Associates, Chicago



WHO LEFT IT THERE? Was it carefully set down resting on the guard, or did it fall off the work and bounce into this position? Even though the guard is on the machine, check the wheel before running it, and let it run a minute before grinding, to be sure it isn't cracked and ready to break.

• Portable grinding machines are probably subject to more abuse than any other type of grinding equipment. It is easier to damage a wheel by careless handling of a portable machine. This can occur when the wheel is at rest as well as when it is in use. Dropping it to the floor or workbench, bumping it into castings and obstructions, or setting it down carelessly can all damage a wheel, causing it to fly apart when brought up to speed and operated under normal grinding pressures.

Vitrified wheels are especially subject to damage from this sort of abuse. Paying attention to the normal rules of safety plus a little common sense as to the nature of grinding wheels will help operators get the most out of their wheels while working under the safest conditions.

Many plants use "V" racks or hooks to support portable grinders out of harm's way when they are not in use. This eliminates one source of trouble. The "V" racks can be installed under most work benches with very little trouble, and they will help keep equipment in good working order.

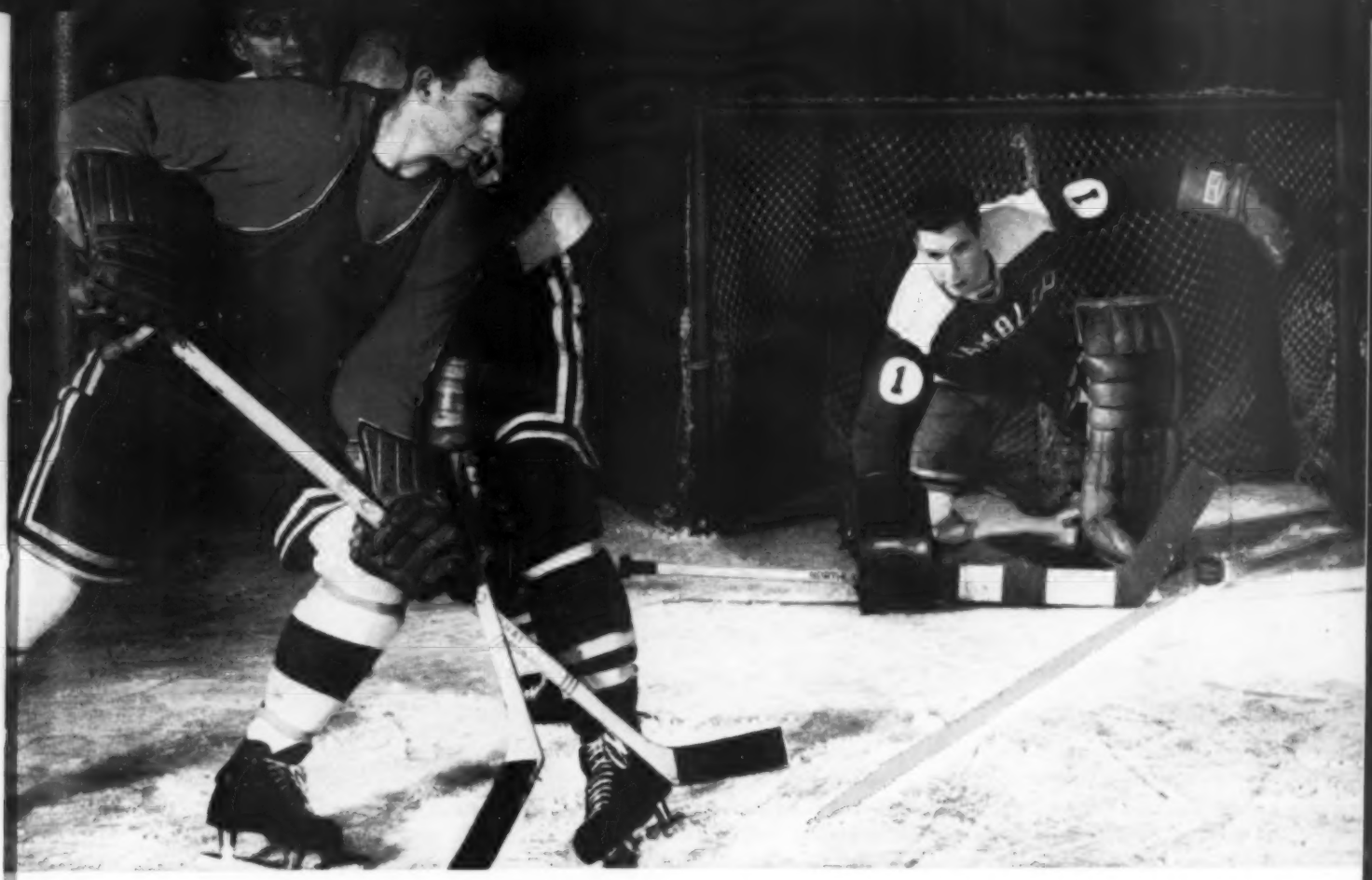
The fact of the matter is that regardless of how carefully grinder manufacturers design their machines, and in spite of the precision with which wheel manufacturers grade and mark their wheels for particular grinding operations and uses, the ultimate result both in grinding performance and safety depends on the operator.

If breakages of grinding wheels could be prevented, there would be no need of guards. At the same time, it is obvious that portable grinders cannot be guarded as well, let us say, as disc grinders or centerless grinders.

It is equally true that the fact that a given wheel can be broken easily is no indication either of poor quality or lack of safety. We must have "weak" wheels as well as "strong" ones in order to perform all kinds of grinding operations. Using the right wheel for the right job is a large part of the answer to this problem.

Hard acting wheels naturally wear less rapidly than softer ones, and as maximum wheel life is desirable, there is a tendency to use harder and harder wheels. However, if the wheel is too hard for the work, the operator will use excessive pressures which set up dangerous stresses in the wheel. If the wheel is too hard for the job, use a softer one . . . it's safer and more productive.

If operators can be trained to mount wheels properly, to operate their wheels at proper rated speeds for particular jobs, to avoid abusive operation and careless handling, they will decrease wheel breakage and increase safety at the same time. • • •



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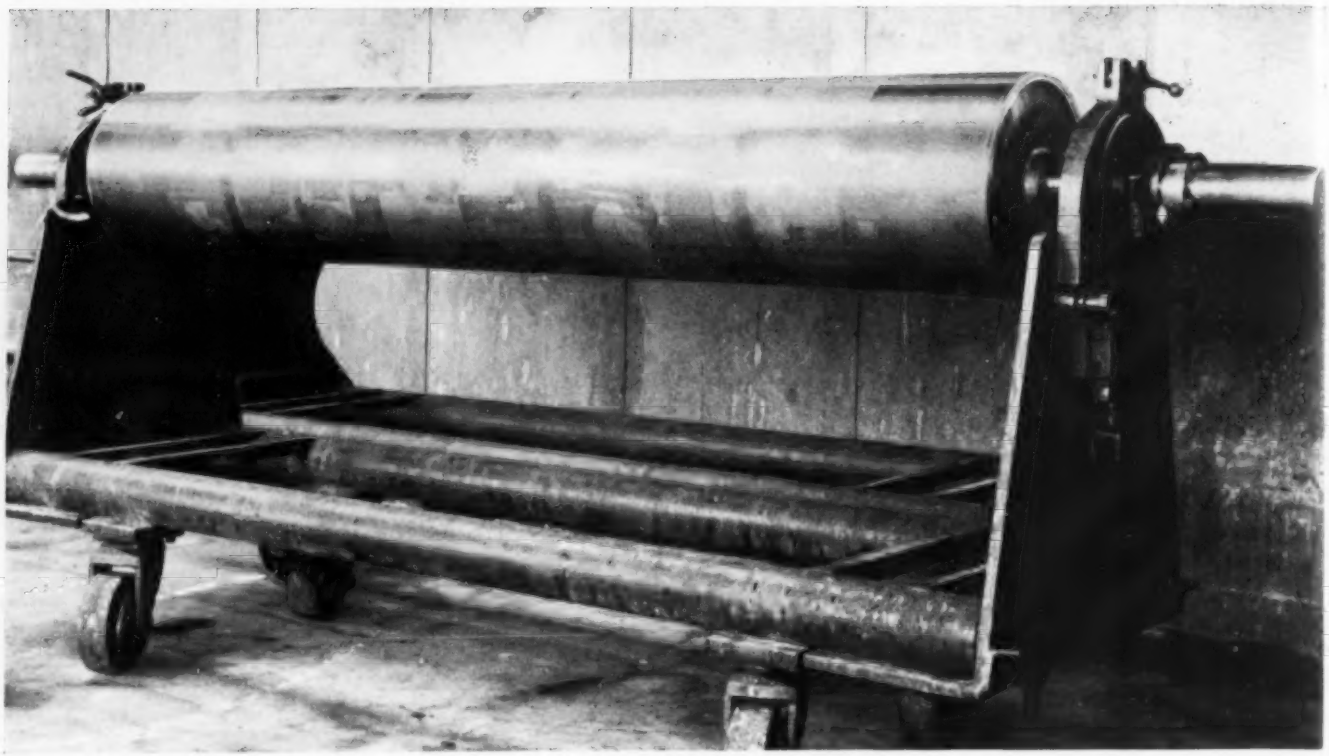


LARGE ROTOGRAVURE CYLINDER which has received its etched printing design. Pre-etching surface is ground and polished to 3 microinch finish.

There's a trick to grinding and polishing

Rotogravure Cylinders

Here's how it's done

Mirror finishes and extreme accuracy of rotogravure printing cylinders call for interesting grinding techniques, including special machines and wheels. Trick is to keep wheels from loading with copper.

● Special techniques have been developed to prepare cylinders used in the rotogravure printing process. The grinding and polishing problem involved can be summarized this way: Grind a copper-plated cylindrical roll up to 70 inches in circumference and 89 inches in length to a 3 microinch finish, holding size limits on a full series of five rolls to less than .0005-inch.

The centrifugally cast steel cylinder arrives at the rotogravure plant with a base copper shell .100-inch thick already on it. To this base copper shell, every time a new printing job is run using the roll, is plated a temporary copper plating .006-inch thick. This final copper shell is the one which must be ground to prepare the cylinder for etching of the printing design of ink cells.

The grinding machines used in the process are special vertical-spindle, traversing head models made by the Standard Process Corporation of Chicago. They are used with special "Intaglio" aluminum oxide abrasive wheels made by Carborundum and sold through Standard Process.

Cylinders are finished by a progressively finer series of grinding wheels. The 7¾ x 3 x 2 Type 5 grinding wheels are mounted on a chuck plate which is attached to a spindle having a combination concentric and eccentric motion. The eccentric motion can be described as shearing off the initial grain or roughness of the copper shell. In the final finishing steps, a purely concentric motion of the wheel combined with a floating action is used.

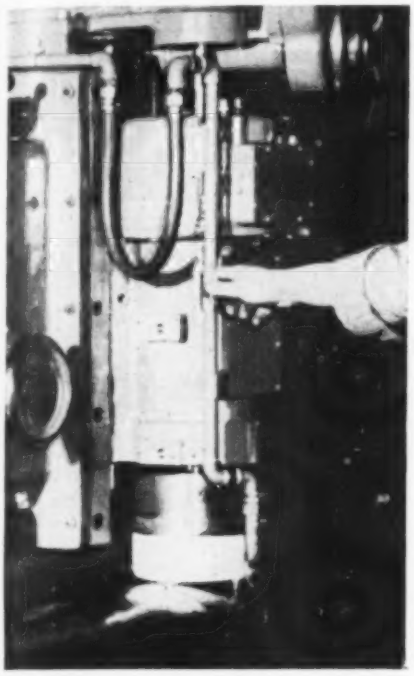
A geared, motor-driven automatic feed mechanism incorporated on the grinding wheel slide operates continuously or at the end of each traverse of the grinding head, compensating for wheel wear.

The finishing sequence used in

most rotogravure plants is as follows:

1. Roughing
   180 Grit used within .006-in. of finished size, then 280 grit until within .004-in. of finish size.
2. Semi-finishing
   400 grit is used until within .001-inch of finished size, and the final finish grind is done with a 600 grit stone.
3. Polishing
   800 and 1000 grit wheels are used for the polishing action, using the floating action of the wheel with practically no downfeed.

The finished cylinder is kept under wraps to prevent severe oxidation and scuffing during the usually brief storage period before etching of the printing design. Following etching, each cylinder receives a light wash of chromium plating for durability during the printing run. • • •

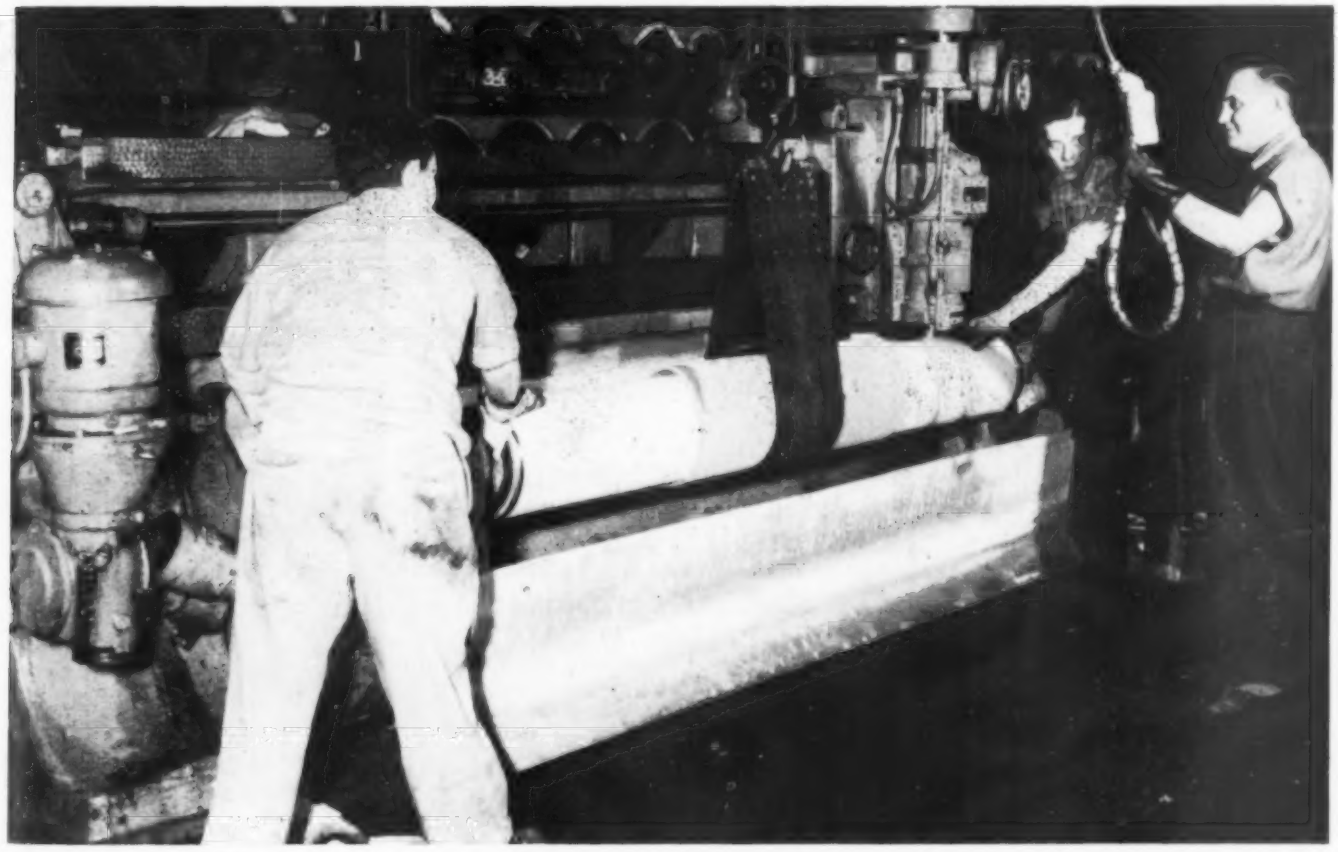


OPERATOR ADJUSTS FLOW of tap water used as coolant in grinding copper-plated rotogravure cylinder. Combination eccentric and concentric motion of vertical wheel is used in first steps.

WHAT IS THE ROTOGRAVURE PROCESS?

Rotogravure is the ultra-high speed process which prints your Sunday newspaper supplement, your Sears catalog, and other printed items which must be reproduced in large quantities. Rotogravure is printing 80 per cent of frozen food wraps and cartons, most high-grade food labels, many of the popular national magazines—even the wood grain design on masonite cabinets of TV sets in the lower price range. Many linoleum designs are also being printed by rotogravure.

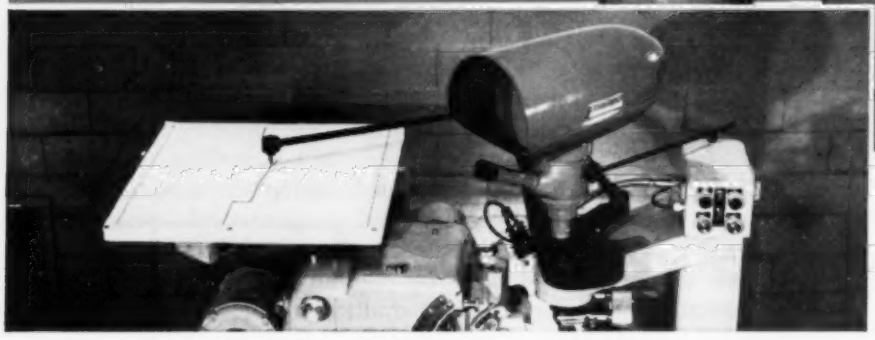
The rotogravure process involves etching microscopic pockets or ink "cells" in the surface of an ultrasmooth printing cylinder. In use on the high-speed presses, the cylinder revolves through a tank of ink. A "doctor" blade of steel, acting like a squeegee, then wipes the ink off the cylindrical portion of the printing roll, leaving the ink only in the small etched "cells," to be deposited on the printed page by capillary action as the cylinder contacts the paper. To print multicolored jobs, it is necessary to have as many printing cylinders as there are colors to be printed.

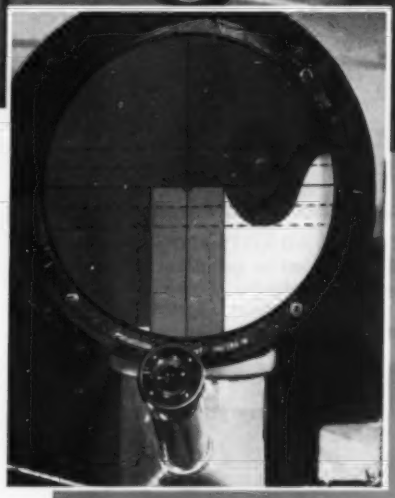


ABOUT 25 CYLINDERS A DAY are processed in the plant of Chicago Rotoprint Company. Here operators lift paper-protected finished cylinder from machine following polishing sequence.

Chicago Rotoprint turns out Sears and Montgomery Ward catalogs, many popular magazines in its modern gravure plant.

Grind High Precision Profiles Directly from the Drawing *with* SHEFFIELD'S MICRO-FORM GRINDER





FEATURES

- Grinds both flat and circular profiles
- No restrictions on profile intricacy
- No templates needed
- Perfect toolroom accuracy
- Saves up to 75% on profile work
- Final accuracy checked while work is still on the grinder
- Accuracy not affected by wheel wear
- No special wheel dressing required as wheel can be set at any angle—fewer wheels are needed
- Diamond impregnated wheels used in grinding carbides last longer—no waste as no special dressing is required
- Multiple work parts ground simultaneously
- Grinds any material including carbides
- Controlled by 50:1 pantograph and 30 power scope and viewing screen

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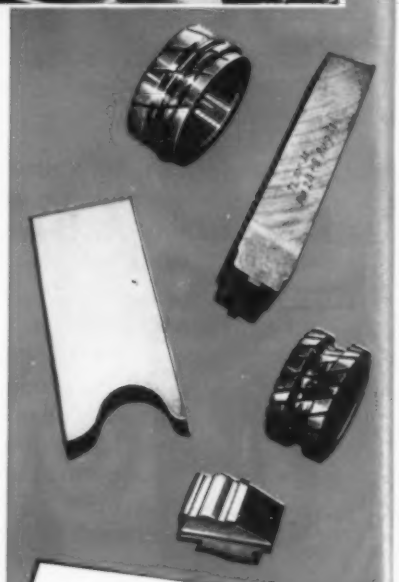

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5. Obtain Smoother Surface Preparatory to Plating!
6. Cut Direct-Labor Costs!

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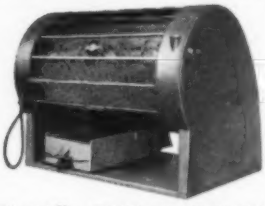
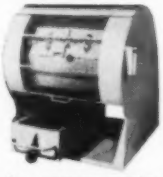


MODEL 66"—TWO COMPARTMENTS

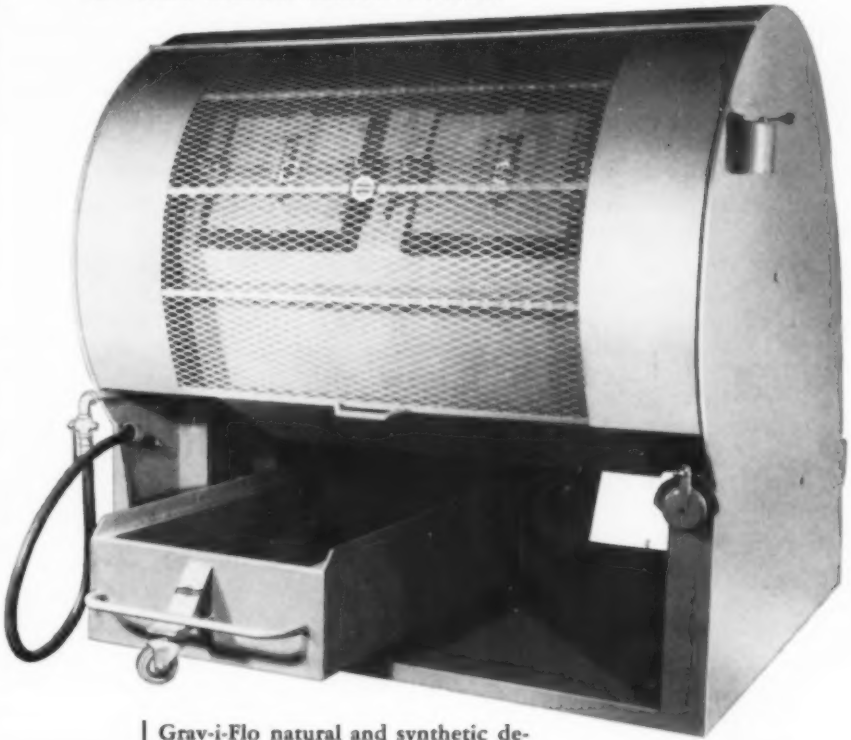
MODEL 36"—TWO COMPARTMENTS



MODEL 32"—TWO COMPARTMENTS

MODEL 24"—TWO COMPARTMENTS

CHIP SEPARATOR AND GRADER



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TWO COMPARTMENTS

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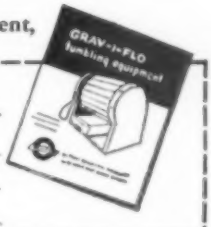

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On This Special Belt Grinding Problem

Silicon Carbide Belts

Provided the Solution

By **Herman Reichardt,**
Consulting Engineer

For a plough share manufacturer silicon carbide belts . . .

- √ Increased Production
- √ Provided better surface finish
- √ Removed scale and not stock

● The application of silicon carbide and aluminum oxide to cloth, fiber and paper backing material is well known; so are the special tools we know in metalworking as abrasive belts or coated abrasives. We use abrasive belts in different dimensions, grit numbers, bonds, etc., according to surface finish demands, operations or rate of desired stock removal, among others.

Extra sharp and fast cutting action is a major advantage of all types of abrasive belts when used properly. How long the initial cutting force lasts depends mainly upon the material to be cut, the machine used, the contact to support the belt and the shape of workpiece, i.e. flat surface, concave or convex contours and how steep these contours are.

Aluminum Oxide Belts

Aluminum oxide and silicon carbide belts behave differently when used on polishing operations. When grinding flat steel surfaces the aluminum oxide belt will have a good cutting force at first, but may dull afterwards and show a glazing appearance when taken off the machine (provided the proper belt type is used). The answer in this case is a harder contact of the serrated type, reducing of contact diameter to the smallest practical dimensions; if this does not achieve a better output per belt, variations in cutting speed may help. Nevertheless, there is a certain limit for every belt performance, dependent upon the type of work the belt has to do.

On aggressive workpieces, when grinding sharp edges, flash marks, fins etc., the belt will almost always be used up to the cloth. To get a better output from the belt, you must increase diameter of contact to retard break-down of bond and increase the cutting speed to strengthen the bond of the belt. In special cases change to a softer contact wheel when grinding softer materials. All these changes will have the desired effect provided the proper type of belt is already on the machine and no other belt type could give better performance than the one recommended by the belt manufacturer.

Silicon Carbide Belts

Silicon carbide belts give a very uniform and fine cut when used for flat steel surfaces but may remove a low amount of steel stock when composed of coarse and medium grit. The grain breaks down regularly until the bond is reached and the belt becomes dull. With heavier pressure applied or more aggresive parts being polished, it is consumed down to the cloth. Knowing this fact of poor stock removal there is quite a change of working ability when applying finer grit numbers for flat steel polishing; in this case no dulling action occurs, as is commonly associated with aluminum oxide belts. Fine grit silicon carbide belts produce a fine, uniform finish on strip or sheet material of either carbon steels or stainless steels.

That does not mean that coarse and medium grit silicon carbide belts do not play a prominent part in belt grinding and polishing. These belts are very efficiently used for grinding aluminum, brass, very hard and brittle materials and many other out-of-the-way metals and alloys such as titanium, nimonic, etc., and all kinds of special jobs.

And there are many operations yet to be detected for applying these belts.

Take the case of a ploughshare manufacturer, who first used a vitrified bonded silicon carbide grinding wheel of 46 grit to remove heavy forging scale from his forged plough parts. This manufacturer wanted to change over to abrasive belts and started tests with a glue bonded aluminum oxide belt of 36 grit along with a hard serrated rubber contact wheel. The diameter of contact was 16 in. running at 1500 rpm. This method did not work. As with the original method he removed a considerable amount of steel stock along with the heavy scale layer and did not get more than about 20 pieces out of one belt. Further tests with resin bonded aluminum oxide belts did not bring him a piece more per belt. As a result he wanted to eliminate the belt grinding method for reasons of poor economy, when a last and definite request was sent to a belt manufacturer to do something on this problem.

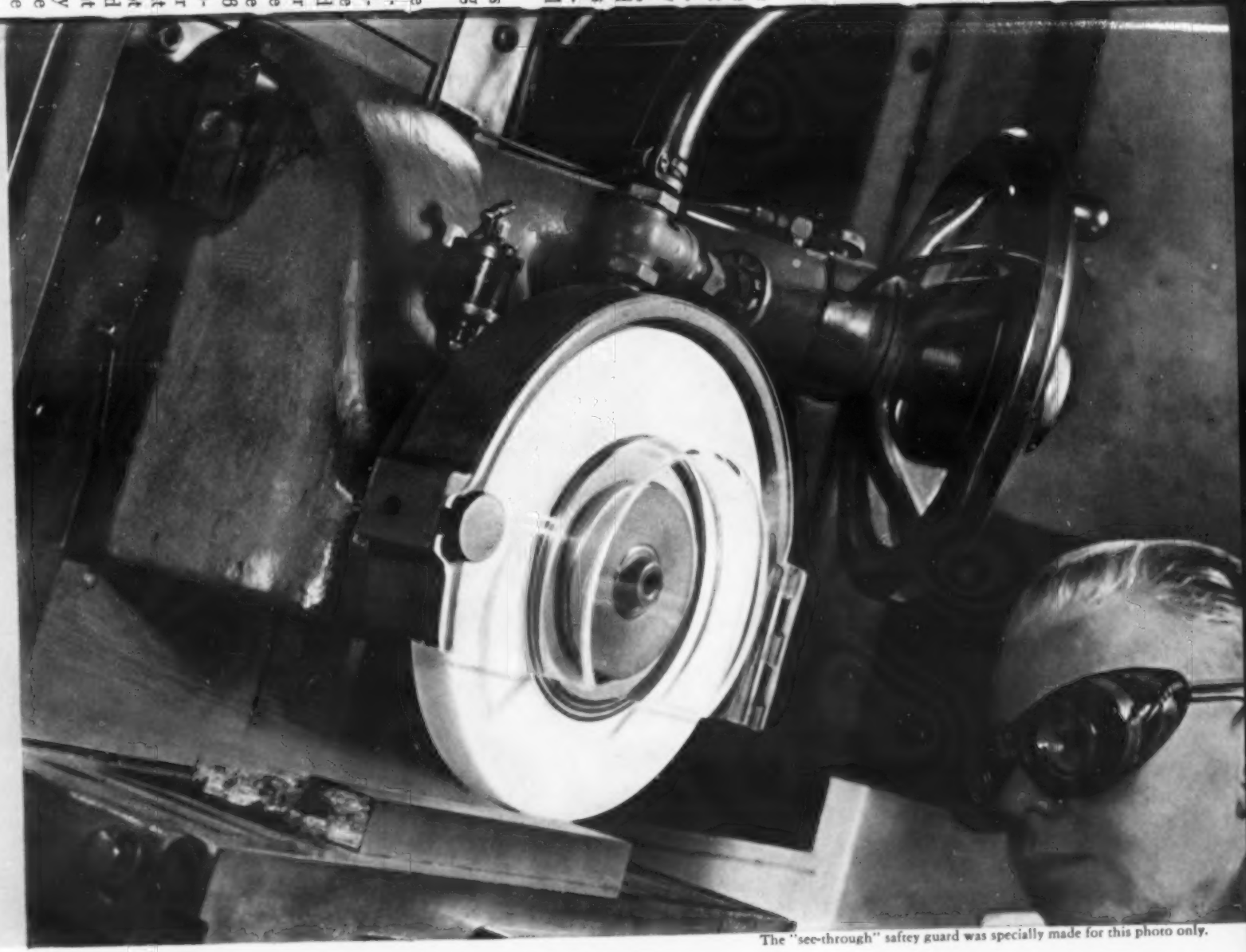
A careful investigation revealed the following facts:

1. The surface of the plough parts had to be improved by belt grinding, which was achieved during the first tests.

IMPORTANT: For your conveni-

IMPORTANT: For your convenience this sheet is perforated. Tear it out and "buck-slip" it to the proper man in your plant.

Here's the famous V40 Tool Room Wheel in action! Two years of proven industry-wide supremacy have made these V40 wheels "a must" in tool room operations. Check the case history on the back of this page.



The "see-through" saftey guard was specially made for this photo only.

Ask the man from **CARBORUNDUM** REGISTERED TRADE MARK **BONDED ABRASIVES DIVISION**

Also makers of a complete line of Coated Abrasives and Abrasive Grain

ATTENTION TOOL ROOM FOREMAN: Turn the page and see the Product Performance Report written especially for you.

Product Performance Report

SURFACE GRINDING HIGH CARBON STEEL

Operation

1. Surface grind to size high carbon, high chrome plunger.

Project

2. Grind, from the solid, in one operation a radius and flat slot in the same mold plunger.

Results

Select wheels to grind without burning or checking the plunger that will produce a fine M. I. finish at a fast production rate.

1. AA46-H8-V40 surfaced the plunger to a total indicated flatness and parallelism of .0002″ maximum, generated a finish of 10 M. I. and produced a uniformly appearing surface that was entirely free from burn and check. The grinding done at these speeds and feeds—

INFEED	CROSSFEED	TABLE SPEED
.003″ per pass	1/32″	50 F. P. M.

2. AA46-H8-V40 on a wet operation ground the complex radius and flat slot from the solid and removed a depth of .376″ in 16 minutes. The form was free from burn and check and measured a maximum of 10 M. I. in roughness.

Note

Carborundum, leader in abrasive techniques, backs up its products with trained sales representatives, a staff of competent field engineers and an abrasive engineering laboratory ... all available to you to put more sense in your abrasive dollar.

Here is another in the series of Product Performance Reports being released by the Bonded Abrasives Division of The Carborundum Company. A color photograph of this actual operation is shown on the back of this page.

• *Ask your local distributor... or the man from*

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2. There was no direct need of cutting the stock, except to remove the scale.
3. Time per unit had to cut a good deal below the time of grinding with a vitrified bond wheel.

After going through practical tests in a testing department to try out several methods and belt types under various conditions final specifications were:

1. Change of contact wheel diameter from 16 in. to 10 in., all other contact specifications remaining untouched.
2. Application of a resin bonded silicon carbide abrasive belt of 30 grit which would create best conditions possible to allow removal of the highest amount of scale.
   Utilizing small contact diameter, hardness and serrations of contact, and brittleness of silicon carbide to a) have a sharp and efficient cutting action and b) have a regular somewhat guaranteed breakdown of bond and abrasive material respectively.
3. Once or twice a change of running direction during belt life to support break down of bond.
4. Avoiding of waste cuts into stock material through the natural inability of silicon carbide to cut deeply into carbon or alloy steels. (coarse grits)

In this case silicon carbide did a very moderate steel-cutting work but removed the scale so efficiently that the practical results were excellent.

The surface was improved considerably because deep cuts into stock, as was the case with aluminum oxide, were avoided.

Practical Specifications

Former time per unit when using vitrified bonded wheel of 46 grit ..... 2–2.5 min.
Time per unit when using resin bonded silicon carbide abrasive belt, 30 grit.....0.6–0.8 min.
Output per belt, 84 x 2 in. ..... 180–200 pieces
Dimension of workpiece (slightly convex) .....8 x 4 in. appr.
Spindle speed .....3000 rpm
Contact wheel dimensions ..... 8 x 2 in.
Type of contact ....hard, serrated rubber • • •

NEVER LOADS THE WHEELS

K-7 solutions do not load work wheels, and this important advantage means (1) fewer dressings, (2) longer wheel life and (3) a true ground finish (rather than a burnished or smeared finish). In addition, with K-7 (because it does not load) you can often use a harder (1-2 grades) and finer (10-20 points) grit wheel, resulting in better work at lower cost.

Investigate K-7 for use in grinding all steels, cast and malleable irons, titanium, carbon, rubber, ceramics and plastics. (Not recommended for non-ferrous metals.) It is an all-chemical water soluble liquid concentrate, transparent and colorless in solution. It is non-foaming and runs absolutely flat under all conditions. Low pH (alkalinity) makes it easy on the skin. Send for details.

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The Economics of Equipment Replacement by Purchase

by **George Terborgh,** Research Director
Machinery and Allied Products Institute

Six years ago I made the following indictment of American industry:

"Most industrial executives believe that their company has a good equipment policy, but it is surprising how few of them can answer these three simple questions:

1. Do you know what equipment in your plant is at present economically replaceable, and on what assumptions as to the future it is so?
2. Do you know what it is costing the company, on the basis of these assumptions, not to make the indicated replacements?
3. Do you have an organizational setup that keeps you currently and continuously informed of available opportunities?

"The fact is, as our investigations confirm, that the average American company—note that I refer to the average—does not have an inventory of replaceable equipment. It does not know what it is costing currently to defer eligible replacements. It does not have an organization set up for keeping management systematically informed of its equipment situation. Replacement is a haphazard, catch-as-catch-can affair, inadequately organized and inadequately informed."

I am happy to say that this judgment sounds today too harsh and sweeping. We have witnessed in the past six years the beginning of a revolution in this formerly backward area of management, a revolution that shows no signs of abating. The proportion of companies that can be embarrassed by the three questions just quoted is by now somewhat diminished. It is however, an understatement to say that there remains much room for improvement.

As clearly implied in the quoted questions, there are two basic requirements for good equipment policy. The first is a reliable analytical technique for appraising the replaceability of particular pieces or groups of equipment. The second is a good administrative setup to provide management with current and systematic information on re-equipment opportunities. On this second requirement I can offer only the briefest of passing comment, since I prefer to discuss only the analytical technique.

Administrative Organization.—I have no illusion that there is any one "best" setup for the administration of equipment policy. There are too many variables to reckon with: the size of the company, the nature of the operation, the character and condition of the facilities, the personalities in management, and so on. But whatever the organization chart, there are certain functional objectives to be achieved.

Let me simply list the principal ones. There should be continuous and systematic review of the equipment situation by an individual or staff specially trained in replacement analysis, and primarily responsible for keeping the situation under surveillance. Re-equipment suggestions and proposals originating with operating executives should be analysed and processed by such specialists, along with proposals they originate themselves. In this work they should be assisted by whatever records it is practicable to keep on

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RESULTS Because ATLANTIC Resinoid-Bonded GRINDING WHEELS are "job-mated," they have a smooth, floating action that requires less pressure, thereby reducing operator fatigue, and they cut cleaner, faster and run cooler on job after job . . . reducing costs to a minimum. Prove it for yourself. Call your nearby ATLANTIC representative or write direct. Atlantic Abrasive Corp., 532 Pearl St., South Braintree, Mass.

A complete line: everything you need for roughing, finishing, and polishing including mounted wheels and points and depressed center wheels.

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factors affecting replacement decisions. They should be responsible for the post-audit of earlier replacement decisions to detect any general, or systematic bias in the expectations entering into the original analyses. Finally, and most important, instead of dribbling re-equipment recommendations up to top management one at a time, as is so often done now, they should supply a comprehensive picture of the equipment situation, with a careful estimate of the expenditure required to make each indicated replacement, together with an estimate of the current annual cost of **not** making it. With such information before it, top management can draw up a re-equipment budget that means something; without it, it is shooting blind.

With this hasty sketch of what a good organization of equipment policy should aim at, let me turn to analytical techniques. These are basic, for without a good technique for analysing individual re-equipment problems, no amount of system or organization can produce satisfactory results.

The-Rule-of-Thumb Approach.—The traditional techniques used by American industry for analysing the replaceability of equipment are extraordinarily primitive. Where they involve anything more than intuition, or unaided judgment, they are simply rules of thumb. The most popular of these is the rule that new equipment must "pay for itself" within a stipulated period or must yield a specified "rate of return."

I have asked many business executives how they make up their minds whether to require a two-year or a four-year payoff, and the nearest I have come to a good rationalization is the occasional statement that the requirement employed will use up the available funds. Many executives appear to have their favorite payoff requirement, just as they have their favorite whisky or cigar. One might infer that we are dealing with a matter of taste. Actually, it is much more than that, for the difference between the equipment policy obtained with a two-year payoff requirement and that obtained with a four-year requirement can be the difference between day and night.

This popular rule of thumb affords no practical guide to its own application. For there is no theoretical limit to the shortness of the payoff period to be required, or to the size of the rate of return. Thus, for example, if it is desirable to demand a 50 per cent return before making a replacement, why not ask for 100 per cent? If 100 per cent is good, why is not 200 per cent better? All we have to do to get the 100 per cent or the 200 per cent, as the case may be, is to defer the replacement long enough. We are sure, eventually, to harvest the profits of procrastination.

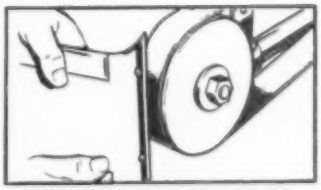
Let me illustrate by analogy. A corporation has a seventy-year-old president. He is getting along, obviously, and the board of directors is persuaded that they can replace him to the advantage of the company. They figure it will profit the concern $25,000 a year to make the replacement. But at this point someone speaks up: "Wait a moment. This fellow is getting older and more senile by the minute. If we wait until he is seventy-five, it will be worth $50,000 a year to get rid of him. If we wait until he is eighty, it may be worth $100,000. Why pass up these additional profits from his replacement?" You laugh. Obviously, the genius who propounds this scheme is a candidate for the boobyhatch. Nevertheless, his logic is still commonly employed in analyzing the replaceability of equipment.

It is obvious that if we could get 50 or 100 per cent in real profit from replacing equipment, nobody could afford to start a new business with new equipment. The way to go into business would be to rummage around the second-hand shops and mechanical graveyards for discards. Having first installed these, the operator would immediately replace them, taking the profits from replacement, after which he would proceed to do business with the successor equipment. The worse the old equipment, the less adapted to the job, the greater, obviously, the profit

Hammond of KALAMAZOO

FOR DEBURRING ECONOMY

Model 50-DD



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Equipment Replacement

continued

from its replacement.

I do not want to press the absurdities of this logic any further, but come at once to the conclusion. The rule-of-thumb devices traditionally popular in American industry do not make sense. They are simply a piece of industrial folklore, handed down from one generation of managers to the next. Their use represents, accordingly, an exercise in mysticism.

If these rule-of-thumb procedures merely yielded capricious results in individual cases, but with no general or systematic bias, they could be regarded with a certain indulgence. It appears, however, with the exceptions to be expected of any generalization, that they operate in the main to delay replacement beyond the point indicated by more rational methods of analysis. Their use results, in other words, in an accumulation of mechanical zombies, to the detriment both of the enterprise concerned and of the economy at large.

Use of Replacement Formulas.—I referred earlier to the revolution now going on in the field of equipment policy. Insofar as it has to do with analytical techniques—of course it affects other aspects of policy as well—it shows a trend toward the substitution of replacement "formulas" for the primitive rules-of-thumb formerly relied on.

A good replacement formula is a valuable tool of management if applied with understanding and discrimination. I must stress this qualification, for there is observable a widespread tendency, once a formula is adopted, to overwork it. It is applied ritualistically, one might almost say superstitiously, to every problem that comes along, regardless of its suitability. A formula is not a piece of magic; neither is it a substitute for hard thinking and responsible judgment. I cannot emphasize too strongly that it can be properly applied only by analysts fully aware of its built-in postulates and assumptions, and fully able, therefore, to appraise its appropriateness to the case in hand.

I am reminded, in this connection, of one of Nietzche's aphorisms: "The man is a thinker: that is to say, he makes things simpler than they are." This is precisely the function of a replacement formula: it also makes things simpler than they are. This simplification is not a defect; on the contrary, it is an inescapable necessity. The variables in most replacement analyses are too numerous, complex, and unpredictable to permit a fully "realistic" solution. A formula supplies the simpli-

fication required to make the problem solvable.

Since the use of formulas is spreading rapidly, and since many companies are considering possible alternatives, it may be worthwhile to set forth the specifications a good formula should meet. With your permission, I should like to outline briefly what I regard as the essential requirements.

A Good Replacement Formula

1. It Must Solve the Right Problem.—It may seem trivial to begin with so obvious a requirement, but I assure you, gentlemen, I have put this one first with full deliberation. It is amazing how often even "highbrow" replacement formulas solve the wrong problem. Obviously, the right answer to the wrong problem may be quite as bad as the wrong answer to the right problem.

Let me cite one example: Many formulas base the replacement analysis on a comparison of the performance of the present and proposed machines **over the estimated service life of the latter**. Thus, if the new machine is given a life of 10 years, it is assumed that the old machine will be kept 10 years longer.

The difference between the performance of the new equipment over its lifetime and the performance that would be obtainable from the old, if continued in service over the same period, is ordinarily of no significance whatever. Even if the old unit is physically capable of service over the full life of the new—which it often is not—the real choice that confronts the analyst is not between retaining it for that interval or replacing it now; it is between **replacing it now or replacing it later.** It is a choice, in other words, between taking the presently available equipment or retaining the existing asset, not 10 years, but for some shorter period. The real question is whether there is **any** period of further service for which its retention is advantageous. This question cannot be answered by assuming that it must be kept 10 years or not at all.

Any formula, otherwise correct, that solves the problem in terms of this erroneous comparison will yield premature replacement signals. Its use will result in a wasteful application of capital funds and higher total costs than are obtainable with a formula that solves the right problem.

2. It Must Make Reasonable and Explicit Projections for All Relevant Variables.—I said a moment ago that the function of a replacement formula is to make an insoluble problem solvable by simplification. The simplification takes the form of a predetermination of some of the crucial variables required for a solution. The predetermination obviates the necessity for specific year-by-year predictions.

What are these variables? Let me mention a few: (1) the operating rate; (2) the duration of the operation; (3) operating costs; (4) service deterioration; (5) obsolescence (the cost and performance of machines to be available later); (6) salvage values; (7) the cost of capital; (8) the mix of debt and equity capital; (9) income-tax rates; (10) tax depreciation methods. There are others.

Any good replacement formula must offer explicit projections for these variables. Only thus can the analyst know what he is assuming when he applies the formula. Only thus is he in a position to appraise the appropriateness of the assumptions to the case in hand and to give proper weight to the results of the analysis.

3. It Must Take Cognizance of Future Obsolescence.—It is possible to measure the **past** obsolescence of an old machine by comparing its performance with that of its current alternative. It is not possible, however, to say just what the **future** obsolescence of that alternative will be. It is not specifically predictable. Nevertheless, few things are more certain than that it will accumulate obsolescence with time, and this accumulation will impair its usefulness and figure among the reasons for its retirement.

No replacement formula can claim to be realistic if it fails to allow for future obsolescence. Yet it is usually

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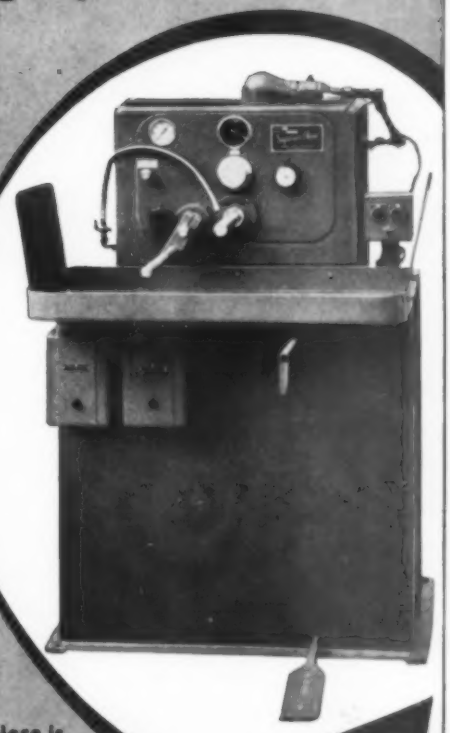

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ignored. This is true, for example, of the orthodox formula of the engineering textbooks, minimum-average-cost. The effect of ignoring it (assuming the formula is otherwise correct) is to signal replacement too soon, resulting in the waste of capital and the higher total costs of which I spoke previously.

The importance of obsolescence as a factor in equipment replacement can be illustrated by a recent study of a small sample of analyses involving machine tools. The tentative conclusion emerged—tentative because of the very limited scope of the study—that on the average something like 75 to 80 per cent of the operating advantage of the new machine over the old represented obsolescence of the latter rather than its physical deterioration. If the truth is anywhere near this, it emphasizes the importance of building into the replacement formula an allowance for the future obsolescence of the presently new equipment.

4. It Must Allow for Differences in Service Values as well as in Costs.—Replacement analyses sometimes go wrong by reliance on the assumption that the service rendered by the old and new equipment is identical; hence, that the only question at issue is the comparative cost of getting it. Certainly this is true in many cases, but in others there are substantial differences in the value as well as in the cost of the service. Dollar for dollar, one difference is as good as the other, a fact that should be recognized and allowed for in the replacement formula.

This allowance should take cognizance not only of the existing service-value differential between the old and the new machines, but also of the possibility that future new machines may render an even more valuable service than the present one. In other words, the obsolescence allowance should cover service-value obsolescence as well as cost obsolescence.

5. It Must Handle Mixed Replacement-Expansion Situations.—This requirement is closely related to the preceding one. The service rendered by the proposed equipment may be superior to that of the old, not only in quality but in quantity. In other words, it may provide additional capacity. If this extra capacity is currently usable, it should be taken into account as a credit to the new machine. Obviously, the replacement formula should provide a ready means for doing so.

6. It Must Allow for the Cost of Capital, Including the Income Tax.—The capital tied up in productive facilities is not a free good. If it is obtained by outside financing, it carries a charge in the form of interest or equity return. If it comes from funds already in possession, it carries an "opportunity cost"—it can earn a return in other applications. No comparison of alternatives involving different amounts of capital tie-up—a situation characteristic of replacement analyses—can possibly be correct without allowing for capital cost.

In making this allowance, the replacement formula must take into account the income-tax cost of capital as well as its cost in interest and after-tax return. Since interest payments are deductible, while equity earnings are not, the tax cost varies with the "mix" of capital as between debt and equity. It varies also with the depreciation method allowed for tax purposes. It follows that a good replacement formula must allow both for the debt-equity ratio and for the depreciation method.

7. It Must Allow for Present and Future Salvage Values.—This is an

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obvious point, but one often neglected. The present salvage value of the old equipment is usually taken into account, though not always correctly. But it is rather uncommon to recognize and allow for the future salvage value of the new equipment. The omission may be of minor consequence in most cases, but it can be very important. A good formula must accommodate this variable along with others.

8. It Must Allow for Future Capital Additions.—Here again is an obvious point often neglected. Some types of equipment require one or more major capital additions over their service life in the form of rebuilds, overhauls, or heavy renewals. These should be projected and evaluated in the replacement analysis, and the formula should of course provide for their inclusion. It should provide likewise for any capital additions required to keep the old equipment in further service.

9. It Must Yield the Cost of Not Replacing.—I come now to a requirement of major importance. No replacement formula can be considered adequate unless it provides management with a reasonable estimate, based on clearly stated assumptions as to the future, of what it is currently costing in dollars per year **not** to take advantage of available replacement opportunities. Such an estimate is a pre-condition of the intelligent administration of equipment policy.

10. It Must be Simple to Apply. I have saved this point to the last, but not to disparage its importance. It is absolutely basic. No matter how carefully contrived and "scientific" a replacement formula may be, it will fail of acceptance unless it is "gadgeted" for easy application. Few practicing analysts are willing to work through a half page of algebra to get the answer. It must be obtainable by at most a quick reference to simple charts or tables. No formula can be good in a practical sense without ease of application.

Here, then, are 10 specifications for a good replacement formula. I suggest that you test your present procedures against this standard. If they conform reasonably well, you are well on the way to a good re-equipment policy. If not, you have an unsolved problem.

MAPI Development Project

Let me turn for a few moments to a different aspect of the subject. You may have noticed that thus far I have not even mentioned the MAPI formula. I think you may be interested in a brief sketch of the development project on the formula the Institute has under way. Please do not construe anything I say as an offer to sell.

The MAPI formula has now been in the field for 5 years. As a result of this experience, we have learned a good many things and have evolved a number of ideas both for the development of the formula itself and for the improvement of its presentation. With your indulgence, I should like merely to list the major items with a minimum of explanatory comment.

1. **Semantics.**—The original presentation of the formula introduced a number of unfamiliar concepts and some special terms coined for the purpose—challenger, defender, operating inferiority, inferiority gradient, adverse minimum, etc. These have proved a distinct handicap to its understanding and acceptance. We hope to work out a reformulation in more customary language.

2. **Graphical Presentation.**—The second item also has to do with the problem of presentation. Heretofore we have made only limited use of graphical methods. We are confident that a great deal more can be done with this approach, and we propose to exploit it for all it is worth.

3. **Choice of Projection Patterns.**—We come now to matters of substance. At present there is available only one projection for the accumulation of deterioration and obsolescence on the proposed equipment. This assumes a constant rate of accumulation. There is no reason, however, why other patterns cannot be provided, thus giving the analyst a range of choice. For example, the projected accumulation rate can be more rapid in the early years of service than later, or slower at first and then faster. With a choice of projection patterns, the analyst can select the one that

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Equipment Replacement

continued

seems most appropriate for the proposed equipment and can achieve a better "fit" than when he has only one pattern for all cases. We are now experimenting along this line.

4. **Precise Income-Tax Adjustments.**—The present formula allows for the income tax by an appropriate "loading" of the interest rate. The result is approximative rather than exact, with deviations depending on the method of depreciation used for tax purposes. For straight-line, declining-balance, and sum-of-digits depreciation, these deviations are surprisingly small, but in the case of 5-year amortization they become substantial. One object of the development project is to provide an exact tax adjustment for the particular method of tax depreciation specified.

5. **Precise Adjustment for the Capital Mix.**—This improvement is closely related to the one just described. The present formula allows for the differing income-tax effects of debt and equity capital by varying the tax "loading" of the interest rate. Here again the result is only approximately correct, and we propose to supply an exact solution for any specified debt-equity ratio.

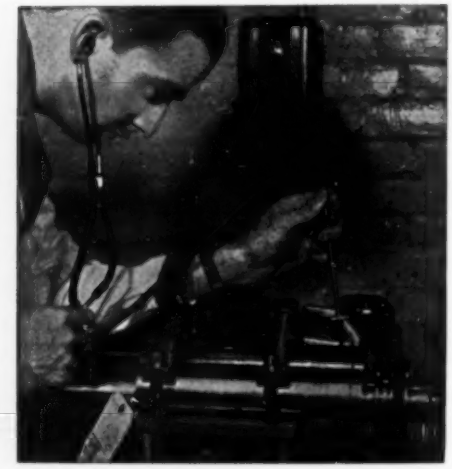
6. **Cash Throw-Back Analysis.**—Financial officers are usually keenly interested in the effect of a replacement decision on the present and future cash position of the company. It is quite possible to schedule the cash throw-backs implied in an investment signalled by the MAPI formula, and we hope to offer a guide to this calculation.

7. **Solutions for Special Situations.**—I emphasized earlier the common tendency to over-use a replacement formula, once adopted. This is as true of our own as of any other. One reason has already been mentioned, lack of clear understanding by the analyst of just what the formula assumes. Another reason, however, is the lack of alternative solutions if the formula is set aside. What does the analyst do then?

The diversity of special situations is so great that it defies standardized solutions, but there are nevertheless a few important types or classes for which formulas are possible. Perhaps the most important of these is the case of special equipment designed for a particular product, the service life being determined by the design life of that product. To such a case the regular MAPI formula is not properly applicable, but we are experimenting with a variant that we hope will do the trick.

8. **Generalization of the Formula.**—The final objective I shall mention is the generalization of our system to cover new-project investment as well as replacements and expansions within existing operations. The present formula was conceived and publicized primarily as a device for analyzing the **timing** of equipment replacements, and it is in this area that it has had its principal application. There is no reason, however, why the basic theory of the formula cannot be applied in the analysis of completely new projects, and we are hopeful that the reformulation now under way will provide a useful guide for that purpose also. Incidentally, this reformulation should facilitate the comparison of new-project and replacement proposals in the preparation of capital budgets.

With this, I must bring my report of the development project to a close. We believe that with the modifications just outlined, the formula will meet completely the 10 specifications outlined earlier, to which the present formula conforms almost completely (the exceptions being the approximative adjustments for the income tax and the debt-equity ratio). We shall consider the time required for this project well spent if it can make a further contribution to an informed and intelligent equipment policy for American industry. • • •



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Types of Automatic Size Control for Micromatic Honing Machines

Gage Ring Microsize

In use for over 12 years, "Gage Ring Microsize" has been and still is one of the most successful means of automatically controlling bore size. In this type of automatic sizing the tool functions as an expanding plug. As the tool rotates and reciprocates through the bore, plastic encased abrasives are forced out radially to keep in constant contact with the work surface. As the self-dressing abrasives remove stock from the bore, the plastic wears at the same rate as the abrasive. The diameter of the tool (across the contact faces of the abrasives) is always exactly equal to the diameter of the bore.

A gage ring with an I.D. equal to the final desired bore diameter is mounted above the workpiece. It is positioned so the plastic tabs on the ends of the abrasives enter the ring at the top of each stroke. When the bore, along with the tool, is the same diameter as the ring, the friction between the rotating plastic tabs and the gage ring causes the ring to turn through a small arc. This movement of the ring triggers an air switch or an electronic pickup initiating the sequence that ends the honing cycle.

Gage Ring Microsize has these characteristics:

1. Geometric accuracy is assured since the "float" of the tool and/or the part is not restricted.
2. Small diameter bores can be easily sized since nothing enters the bore but the tool.
3. There is nothing entering the bore that might mar the surface finish.
4. The equipment is simple to operate and maintain.
5. Production-proved diametric accuracy is .0003 inch or less.
6. Can be used on bores from .070 to 4 inches in diameter.

Gage Bar Microsize

In this type of automatic sizing the bore is gaged by two bars that float on the body of the tool. The bars are held out against the bore by spring pressure. The distance between the contact faces of the bars is the measure of the bore diameter. These bars are fastened to a split ring, hinged at a point 90 degrees from the bars. Opposite the hinge, and positioned to permit easy access, are two low potential electrical contacts, one of which is adjustable.

When the tool enters a rough bore the bars are pressed in and the contacts are held apart. As the bore is honed the contacts move closer together. When the bore is "to size" the contacts meet and the cycle is terminated.

Gage Bar Microsize has these characteristics:

1. Wide range of adjustment. Diametric size will be held accurately as contacts are adjusted for bores varying as much as .040 inch in diameter.
2. All elements carried on tool, no brackets required; float of the tool is not restricted.
3. May be used on large diameter bores (4 inches and over).
4. Simple to adjust and maintain.

Gage Plug Microsize

In this type of size control a plug having the O.D. equal to the desired bore diameter tries to enter the bore at each reciprocation of the tool. It may be mounted around the drive shaft of the tool (but floating independent of the tool), or, in the case of a horizontal machine, it may be mounted at the opposite end of the bore.

The plug is attached to a concentric, metallic bellows. The pressure that causes the plug to try to enter the bore is the result of air expanding the bellows as the tool strokes through the bore. The flexibility of the bellows provides "float", permitting the plug to align itself with the bore.

When the workpiece is honed to the desired size the plug enters the bore. This triggers a switch in the air circuit and terminates the honing cycle.

Gage Plug Microsize has these characteristics:

1. It can be used on deeply counterbored parts.

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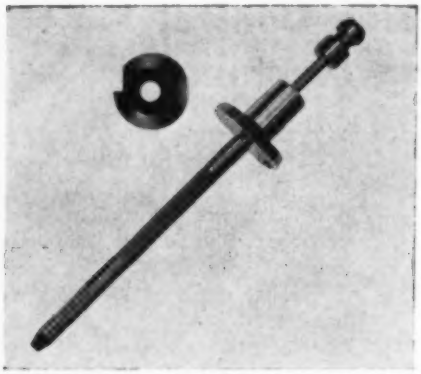
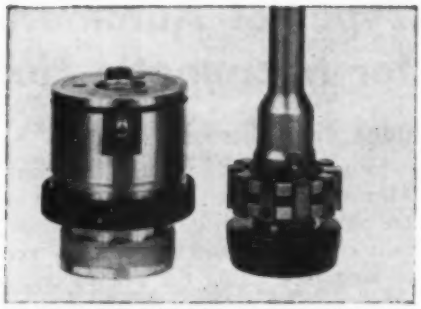


.500-INCH DIA. honing tool and Microsize gage ring used in gage ring system.



GAGE PLUG MICROSIZE unit and honing tool with which it is used. The gage plug assembly is fitted over the driveshaft and is located just above the abrasives. The part at the lead end of the tool is a pilot guide.

2. It is not affected by the stroking speed.
3. It is simple and easy to maintain.
4. Will hold diametric accuracy to .0003 inch.

Gage Air Microsize

(Visual-Air)

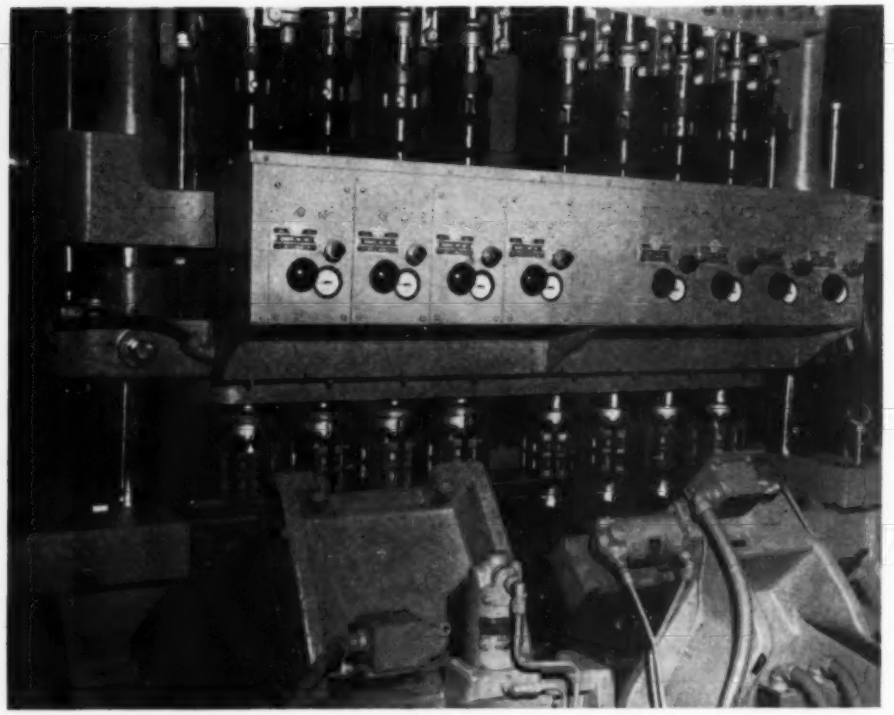
One of the latest developments in automatic size control, Gage Air Microsize consists of an air gage that (as the bore approaches final size) enters the part on each reciprocation of the tool. The gage strokes with and around the drive shaft of the tool, but floats independent of it. The gage is slightly smaller than the finished bore diameter. As the bore approaches the desired size the gage indicates the diameter on a dial. When there is the proper clearance between the gage nozzles and the bore, the decreased back pressure drops out a pressure switch and initiates the sequence that ends the honing cycle.

The pneumatic controls are divided into two parts. One component (consisting of a regulator, restriction and booster unit) is mounted on a bracket as close as possible to the tool. This proximity assures fastest reaction and closest precision control. The second component (the visual size indicators, and size adjustment controls) is placed in a remote control console.

Gage Air Microsize has these characteristics:

1. Diametric accuracy of .0002 inch.
2. Adjustability holds accuracy through a range of .004 inch (change of bore size).
3. Remote adjustability while machine is in operation.
4. Visual indication of stock being removed.
5. Easily checked and calibrated.

• • •



GAGE AIR MICROSIZE on an 8-spindle honing machine. Each tool has its own regulator, restriction and booster relay units located directly in front of it (on a horizontal bracket). The abrasives and gaging sleeves may be seen on the tools just below the bracket.

Grinding and Finishing

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Erickson Tool Co., E. 23rd and Hamilton Ave., Cleveland 14, O.

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Cincinnati Grinders Inc., Cincinnati 9, O.

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Jones & Lamson Machine Co., Springfield, Vt.

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All data in this 35-page handbook is based on successful experience in operating cylindrical grinders. It has been especially designed for use as a permanent and valuable reference. It contains charts of grinding wheel speeds and gradings. One section covers practically all grinding troubles and gives helpful hints on how to correct them.

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Wall Chart of Conversion Factors

A reference table for engineers and executives in wall chart form includes common conversions such as inches to centimeters or watts to hp as well as

many conversions that are difficult to locate in reference manuals (atmospheres to kgs/sq. cm, cm/sec to miles/hr, cu. ft. to liters, microns to meters, quintal to lb., etc.).

Precision Equipment Co., 3716 N. Milwaukee Ave., Chicago 41, Ill.

Use postpaid card. Circle No. 12

Hydraulic Sequence Actuator

The Hydra-Cam, a two-speed (rapid traverse and work cycle) cam-driven, multiple-circuit hydraulic power and sequence control unit for actuating feeds, chucking or clamping, loading, unloading, and gaging on production equipment, is described and illustrated in bulletin. The return stroke of each power piston is actuated by energy stored in a hydraulic accumulator during the power stroke; thus the piston rod roller is always in contact with its cam. All motions are cam controlled in both directions.

Earl A. Thompson Mfg. Co., 1300 Hilton Rd., Ferndale, Mich.

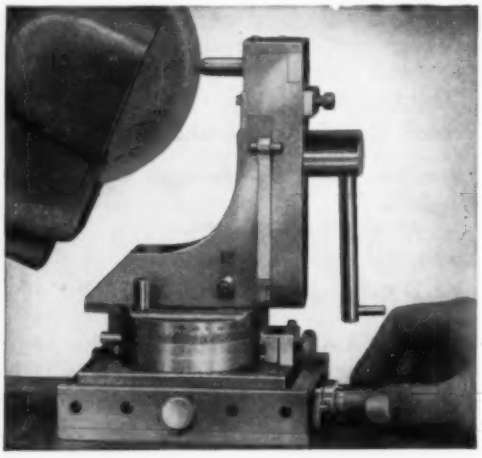
Use postpaid card. Circle No. 13

Tough Grinding Wheel Forms Dressed Easy as A, B, C

eliminate elaborate set-ups and operations

.0001" ACCURACY

Fluidmotion
WHEEL DRESSERS
dress two angles tangent to a radius in one continuous motion



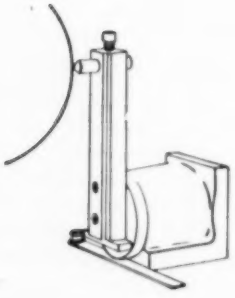
With the unique "Fluidmotion" Dresser, you can dress two angles tangent to a radius — using one handle in one continuous motion. Operation is so fast and simple that beginners can use them.

Adaptable to all type cylindrical and surface grinders.

A. Obtain micrometer reading; add required convex radius or subtract required concave radius.

B. Loosen jib with wrench and "mike" over lower pins to reading obtained above.

C. Tighten jib. Set stops for two angles. Ready for action.



Also available: "FORM MASTER" Dresser, capable of dressing any radii up to 12" convex, up to 15" concave.

See your industrial distributor or write for free literature.

WHEEL DRESSERS J&S TOOL CO. INC. JAW CLAMPS • PRECISION VISES • DOWN-HOLDING DEVICES **CLAMPCUT**

J & S TOOL CO., INC. | 880 DORSA AVE. LIVINGSTON, NEW JERSEY

Use postpaid card. Circle No. 239

Diamond Wheel Dresser

Grinding wheels can be dressed accurately in a few seconds with the Jiffy diamond wheel dresser. It fits all standard machines; has demountable diamond. The unit is simple to attach, easy to adjust to dress absolutely true.

Flyer from American Standard Co., Southington, Conn.

Use postpaid card. Circle No. 14

X-Type Foundry Wheels

Resinoid wheel for foundry grinding are presented in a six-page folder. Wheels can be used on swing frame grinders, floor stand grinders, portable grinders using straight wheels, portable grinders using cup wheels, portable grinders using cones. Manufacturer claims increased cut rate and wheel life.

Precision Grinding Wheel Co., Philadelphia 36, Pa.

Use postpaid card. Circle No. 15

Portable Tools

Catalog of industrial construction and automotive portable power tools highlights ten additions to the line. New saws are a 6½" super duty tool and a 4¼" standard duty trim saw. High-speed hand grinders, disc sanders

and polishers, as well as bench and pedestal grinders, are featured.

Skil Corp., 5033 Elston Ave., Chicago 30, Ill.

Use postpaid card. Circle No. 16

Angle Wheel Dresser

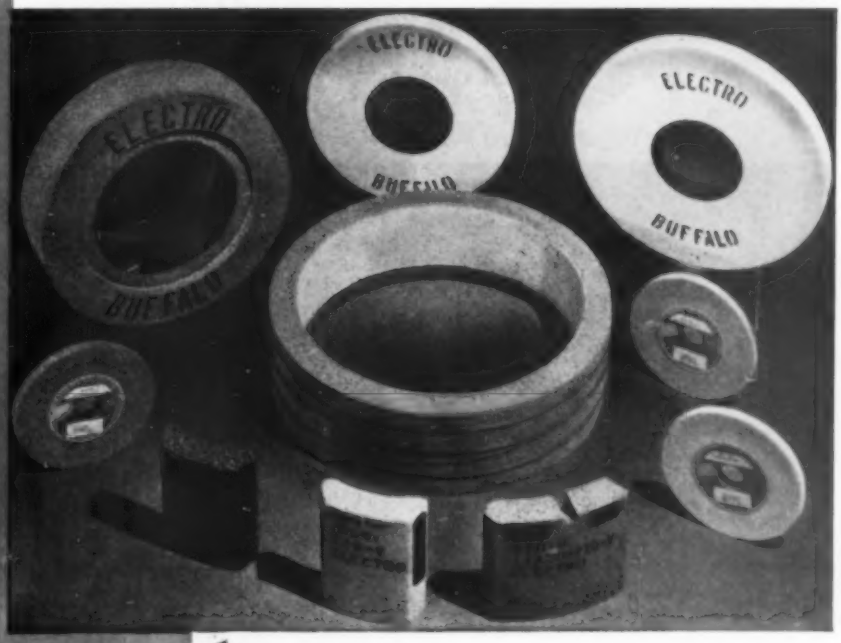
Flyer describes a tool which eliminates the necessity of special equipment or makeshift setups for dressing the wheels of surface grinders to required angles—from 0° to 90°. Angles are accurate within plus or minus 10 seconds.

American Standard Co., Plantsville, Conn.

Use postpaid card. Circle No. 17

NEW VITRIFIED GRINDING WHEEL DEVELOPMENT by ELECTRO!

A MODERN APPROACH TO PRECISION SURFACING WORK



Electro SINCE 1919

"20 STRUCTURE"

. . . presents an entirely new type of grinding wheel construction. The unique induced porosity of Electro "20 STRUCTURE" gives wheels and segments a grinding quality particularly desirable for surface grinding.

USE "20 STRUCTURE" FOR—

- COOLER GRINDING
- RAPID STOCK REMOVAL
- HEAVIER CUTS
- ELIMINATION OF BURN AND HEAT CHECK
- TRUE SURFACE FLATNESS

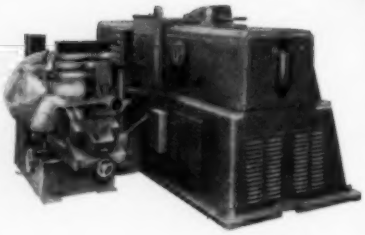
A TEST

"20 STRUCTURE" may well raise your standards of good surface grinding performance. Why not order a trial wheel or set of segments for your surface grinding application!

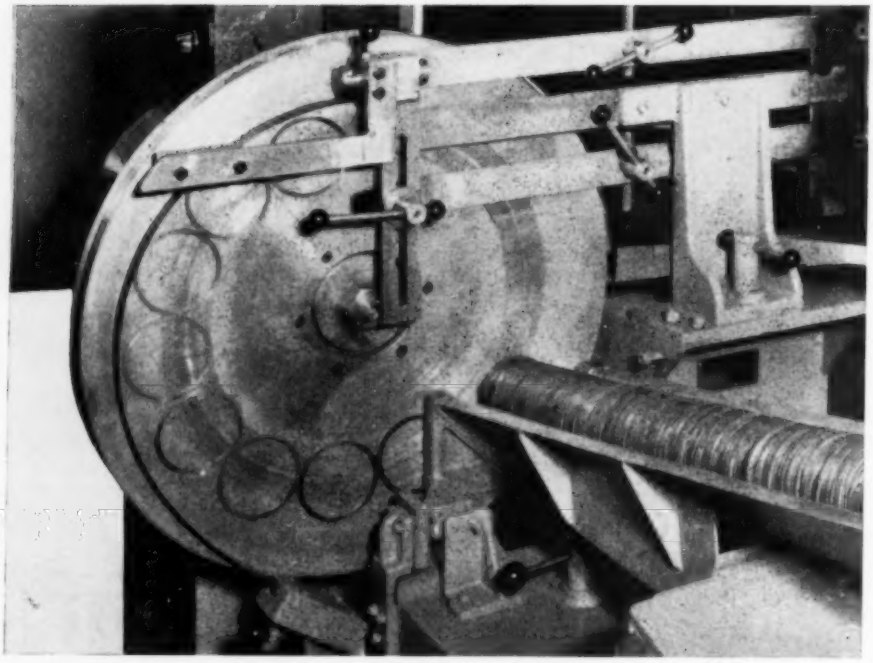
Electro Refractories & Abrasives Corp.
BUFFALO 2, NEW YORK

Use postpaid card. Circle No. 240

MAGNA-LOCK magnetic ROTARY FEEDER



helps this disc grinder turn out six piston rings at each tick of the clock...

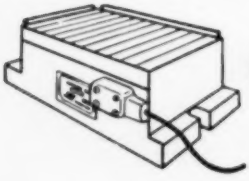


supplies continuous flow of pieces to the abrasive discs, permits full utilization of grinder's capacity

The Besly No. 240 Double Horizontal Spindle Grinder was developed to meet today's demands for ever increasing accuracy and speed. It's only natural that this machine incorporates automatic feeding—and only natural that a Magna-Lock electro-magnetic Rotary Feeder was selected.

Magna-Lock magnetic chucks and holding devices have solved many apparently unsolvable problems of holding, transferring and feeding. Perhaps Magna-Lock can solve *your* problem, too. Our engineers will be glad to work closely with you. Just write Dept. GF-37

Request Magna-Lock as original equipment on your new machines.



Hanchett MAGNA-LOCK CORPORATION
BIG RAPIDS, MICHIGAN, U.S.A.
designers and makers of a complete line of magnetic chucks and devices.

Use postpaid card. Circle No. 241

Free Literature

continued

Grinding, Polishing, Buffing Machines

"The Production Story" briefly describes and illustrates abrasive belt machines for centerless grinding, polishing and buffing—surfacing and straight line finishing. Booklet also tells of well-equipped laboratory maintained for research and development work and for customer service.

Production Machine Co., Greenfield, Mass.

Use postpaid card. Circle No. 18

Customer Education Program

"What You Should Know About the Carboloy Customer Education Program" points out that the courses provided by the program are designed so that anyone who buys, uses or services cemented carbide products may benefit. The booklet describes why the program was created, type of schedules followed, school equipment and facilities and methods of instruction. It also includes information for enrolling.

General Electric's Metallurgical Products Dept., Detroit, Mich.

Use postpaid card. Circle No. 19

M-B PNEUMATIC GRINDERS

UTILITY MODEL U-TR

60,000 R.P.M.
A STURDY, ALL-AROUND TOOL

An outstanding, powerful, fast-cutting tool of proven high efficiency. Designed for the tough jobs and real production. Performs indefinitely and dependably. Precision made. Extra heavy spindle of special alloy steel. Grease-sealed bearings, no manual or automatic lubrication required. Steel housing for safety. Also other models.

WRITE FOR LITERATURE

M-B PRODUCTS
46 VICTOR AVE., Div. 21
DETROIT 3, MICHIGAN

Use postpaid card. Circle No. 242

Grinding and Finishing

New Equipment and Materials

For further information on any of the products listed here, use the handy postpaid card opposite page 72.

New Ellstrom Indicator Gage for Shallow Slots, Grooves

A new line of adjustable indicator gages developed specifically to provide quicker, more accurate measurement of critical dimensions of shallow slots, grooves and holes has been announced by Ellstrom, Inc., Dearborn, Mich.

Called Shalo-Chek, the new gage is only 1 13/16 inches high, and can be used right at the machine to check depths ranging from 1/ 32 to 1/2 inch —in most cases without moving the table or disturbing the set-up in any way. Three standard models are available for checking dimensions ranging from ½ to 6 inches, 4 to 12 inches, and 10 to 18 inches.

According to the manufacturer, the gages can be used with Number 1 AGD standard dial indicators, or with any air gage instrument by means of an adapter block and a contact air cartridge. Each model is furnished complete in its own case, which includes a pair of carbide contact gaging fingers, two wrenches, an adapter block for O.D. checking, and five sets of rest buttons to gage at depths of 1/32, 3/32, 5/32, 7/32 and 9/32 inches.

Since there is no "feel" involved in the use of these gages, readings taken by different persons will always be the same for a given part, the company also points out. •

Use postpaid card. Circle No. 101

MODEL 738 MICROHONER for Square-Axis Honing — Automated honing machine generates bore square with the flat end faces to provide locating surfaces for subsequent operations. Automatic loading of parts is done by large-capacity loader and gravity chute which carries parts to pre-feed position. A plunger moves part onto fixture table. Automatic feeding and aligning of parts: As table rises, part slips over tool which expands to align part with spindle. Part is then clamped on its end faces, in the fixture, square with the spindle. Automatic sizing ends honing cycle when bore is to required diameter. Automatic after-gaging of finished part by dial air gage occurs while next part is being honed. Automatic segregation of parts is controlled by air gage; as parts leave machine they are segregated according to bore diameters.

Shown: Two Model 738 machines mounted side by side for high volume production.

Micromatic Hone Corp., 8100 Schoolcraft, Detroit 38, Mich.

Use postpaid card. Circle No. 102

continued

Covel Introduces 10x16 Surface Grinder

Offering large capacity at low cost, the new Covel No. 17 hand feed surface grinder is particularly adapted to die block and general tool room work. Set up time and operating effort are reduced and accuracy is increased by a combination of features ordinarily not found on machines in its price range.

The elevating handwheel is located conveniently below table level so that both point of wheel contact and handwheel graduations are simultaneously in view of the operator.

Hard chrome table ways are available for extra resistance to wear, maintaining accuracy and eliminating necessity of periodic rescraping. The hard chrome surface is applied after ways are hand scraped from a master plate.

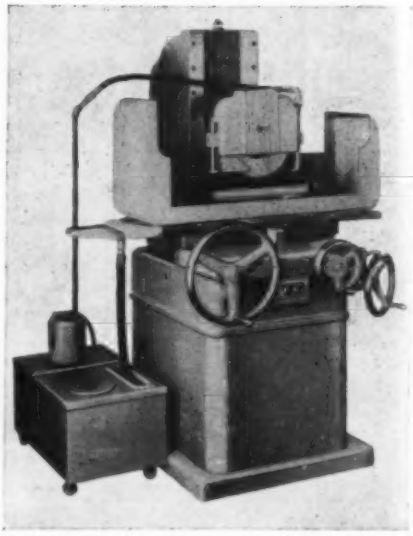
The table is actuated by a timing belt drive which eliminates the rack and pinion, a common cause of uneven grinding. Only 2¾ turns of the large diameter handwheel moves the table the full 16 inches.

Spindle is grease lubricated and sealed for life ball-bearing type direct driven by 2 HP 1750 rpm motor.

Addition of pump and tank unit converts the Covel No. 17 into an efficient wet grinding machine. Separate motor with direct drive to a centrifugal pump delivers coolant through piping and an adjustable nozzle to the work. Splash guards confine coolant and spray to the table with a flexible hose returning coolant to the tank.

Bulletin 716, Covel Manufacturing Co., Benton Harbor, Mich. •

Use postpaid card. Circle No. 103



Covel 10x16 surface grinder has elevating wheel at waist level.

suspension type

FLEXIBLE SHAFT MACHINE

eliminates tooling problem for I.B.M.

International Business Machines Corporation had the problem of reaming holes .813" in diameter in the mounting hanger on the main base of their 407 Accounting Machine. To eliminate expensive tooling for this operation, they selected a STOW V50 portable flexible shaft machine, which was specially fitted with an on-off switch mounted on the handpiece.

The V50 machine delivers 1150, 2100, 3450, or 5750 RPM, is furnished with a 6 foot flexible shaft. Other speeds can be achieved by using different size pulleys. (I.B.M. ran the reamer at 750 RPM.) Available in either ¾, 1, 1½ or 3 HP, the V50 can be used for grinding, buffing, sanding, wire brushing and drilling.

STOW MANUFACTURING CO.

310 Shear Street Binghamton, New York

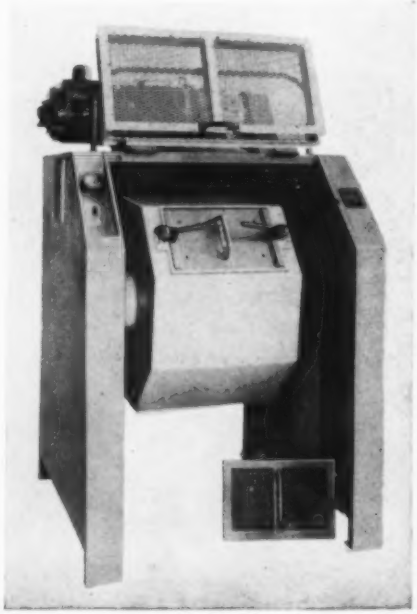
Use postpaid card. Circle No. 243

Abbott Variable-Speed Barrel

A new finishing barrel with variable speeds has been developed by The Abbott Ball Co.

The new addition to the Abbott line features a 22-inch-by-33-inch barrel of welded steel plate with a capacity of 1,200 pounds. Available in either single or double compartment units with or without neoprene linings, the barrel operates at speeds from seven to 30 RPM. Among modern safety devices and controls are a poppet-type venting valve, a guard which functions as an automatic cut-off switch when raised, and recessed controls. •

Use postpaid card. Circle No. 104



Abbott variable-speed finishing barrel.

Johnson's major contribution to coolants fits today's high-speed production needs!

Coolants were just coolants for 50 years until Johnson's Wax Research developed formulations using *waxes* and *wax-type synthetics*. Johnson's Metalworking Fluids are as modern and efficient as your 1957 machine tools. They give you superior performance even on your toughest jobs — because Johnson's lubricates and cools under conditions where ordinary coolants fail because of extreme heat and pressure.

Use Johnson's on your fastest machines, with your hardest-to-machine metals, and compare results obtained with conventional coolants. In hundreds of shops across the country, Johnson's coolants for machining, cutting and grinding are reducing costs and increasing profits.

Your local Johnson's industrial distributor will be glad to set up an in-your-shop test of TL-131 — or any of the complete line of Johnson's Metalworking Fluids. Ask him about Johnson's money-back *Guarantee of Superior Performance* over ordinary coolants.

from
Johnson's Wax Research

S. C. Johnson & Son, Inc., Industrial Products Division, Dept. D-57, Racine, Wisconsin

"Johnson's" is a trademark of S. C. Johnson & Son, Inc.

Pictured below is Johnson's TL-131, one of a complete line of modern coolants for today's high-speed grinding.

NEW DESIGN in HONING TOOLS provides

few parts

quick-loading

simple construction

low tool maintenance

easy stone-replacement

improved wear characteristics

greater abrasive support

for bores up to 4"

This new BarnesdriL Honing Tool design means more efficient honing operations because it supplies better abrasive wear characteristics and greater strength at the point of cutting. The tool has very few parts in its simple construction, and may be designed for use with either a floating or rigid fixture. BarnesdriL wing-type abrasive stones are press-fit between standard hardened inserts which act as side supports for the stones as well as guides in the bore. Fiber jackets reduce stone wear by protecting the inserts against the abrasive and serve to hold the wing-type stones firmly in place.

Fully protected by patents, this new honing tool will improve your honing operations and reduce honing tool costs on honing operations. See your BarnesdriL representative, or send us prints of your honing operations for recommendation.

50th year

BARNES DRILL CO.

886 CHESTNUT STREET • ROCKFORD, ILLINOIS
DETROIT OFFICE: 3419 South Telegraph Road

Use postpaid card. Circle No. 310

Simonds "DA Borolon" snagging wheel.

DA Borolon Abrasive Improves Cutting Action and Prolongs Wheel Life

Faster metal removal with longer grinding wheel wear is now available to steel mills and foundries through Simonds Abrasive Company's high-speed, resinoid bonded snagging wheels made with a new and improved type of aluminum oxide abrasive.

Tradenamed DA Borolon, this fused crystalline aluminum oxide has smaller crystalline structure within each cutting particle. This provides inherent toughness for greater resistance to fracture under grinding strain, and at the same time presents a continuous succession of more and sharper cutting edges on the wheel face. On repeated tests on swing frame, floor-stand and portables, Simonds DA Borolon wheels have proven definitely superior in standing up to the severest stress of production snagging.

Simonds Abrasive Company, Tacony and Fraley Sts., Philadelphia 37, Pa.

Use postpaid card. Circle No. 105

Pedestal Tool Grinder

A new pedestal tool grinder manufactured by South Bend has no bulky motor between the wheels. With wide-open spaces around each grinding wheel the operator's arm movements are never cramped, so his work is said to be faster, more accurate. Setting the grinding wheel spindle forward on the pedestal provides more work room around the grinding wheels. This offsetting of the spindle also allows more toe room for the operator while standing at the machine.

The motor is protected from abrasive dust, and the motor's interior mounting design has removed the weight of the wheels from the motor bearings.

South Bend Lathe Works, 425 East Madison St., South Bend 22, Ind.

Use postpaid card. Circle No. 106

If *your present method of sharpening small cutters . . .*

is SLOW, INACCURATE, COSTLY—

is GIVING POOR CUTTING EDGE AND FINISH—

is CAUSING RUN-OUT IN SHARPENED CUTTERS—

is CONSUMING TOO MUCH TIME CHANGING SETUPS—

is TYING UP A LARGE EXPENSIVE MACHINE FOR SMALL WORK—

YOU NEED A CENTRA•POINT CUTTER GRINDER

Centra•Point's 12 advanced features *really can* overcome all these problems by mechanically performing functions which are troublesome and time-consuming on standard grinders. For full details write today for Bulletin M-55.

Manufactured in Boston

WILLIAM H. FIELD CO., INC.

SINCE 1880

331 Dorchester Ave., Boston 27, Mass.

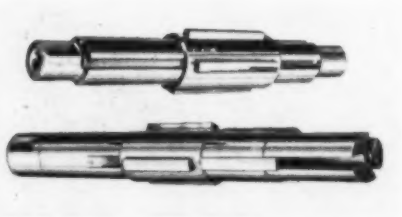
Use postpaid card. Circle No. 244

continued

New Erickson Expanding Jaw Mandrels

A new line of expanding jaw mandrels that are used as internal chucks for gripping and driving bored parts during machining is announced by Erickson Tool Company. Known as Erickson-Nicholson Type Expanding Jaw Mandrels, they are guaranteed to be concentric within .0015 inch TIR.

Erickson-Nicholson Type Mandrels eliminate the time-consuming job of searching for and turning a solid mandrel and the costly delays of machine down-time. On production runs with permissible wide variation of bore tolerances, one Erickson-Nicholson Mandrel often replaces a dozen or more solid arbors, according to the manufacturer. Parts as long as the arbor can be handled since there is no collar to interfere with long work. In addition, work can be placed on the mandrel in position most convenient to the operator. A light tap with a soft hammer drives the mandrel tight or causes it to release the workpiece.



Erickson-Nicholson Type Expanding Jaw Mandrels for use on lathes, milling machines, grinders, shapers, planers or other types of machine tools where work can be held between centers.

Type A Erickson-Nicholson Mandrels are step-jaw design and are supplied in five sizes to accommodate all ID sizes from ½ to 4 inches. The ½ inch size has a three-step jaw; the four larger sizes have two-step jaws. Type A Mandrels accommodate hexagonal broached holes as well as round holes.

Type B Erickson-Nicholson Mandrels are of straight-jaw design. They are produced in 14 sizes to take all bores from ½ to 7 inches. Type B Mandrels are heavier and handle a greater variety of work than Type A Mandrels. Furthermore, Type B Mandrels can be used in either square or round holes. Both Types A and B Mandrels are sold individually, or in sets of any desired combination of sizes.

Erickson Tool Co., East 23rd and Hamilton Ave., Cleveland 14, O. •

Use postpaid card. Circle No. 107

Rotary Table

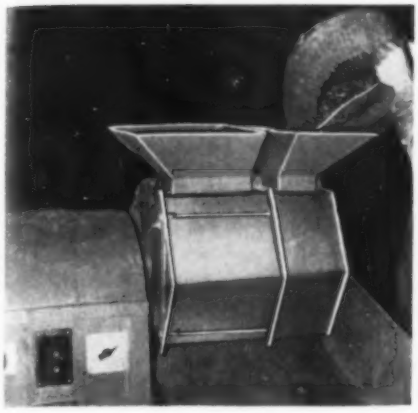
A new 12" rotary table designed for simplification of circular and rotary machining operations of all kinds is announced by the Universal Vise and Tool Company. The new table features a base allowing both horizontal and vertical operation. Selling in a low price range, the table incorporates a ground lead screw. The main bearing is bronze. Center-hole runout is guaranteed to be no more than .0005" and parallelism through 360 degrees of rotation is guaranteed to .0001". All flat working surfaces are ground true and square and the table rotates on a scraped flat bed. Provision is made for full lubrication of all working parts. There is provision for throwing the rotating gearing to neutral to allow for rapid hand rotation for quicker set ups. Two parallel clamping ears and adjustable keys are provided for location and clamping the unit to a machine table in the horizontal position. •

Use postpaid card. Circle No. 108

12-inch rotary table introduced by Universal Vise and Tool.

BLOHM
HORIZONTAL
SURFACE GRINDERS*
You'll be Amazed...
at the high quality job you can do with BLOHM's new line of horizontal surface grinders . and even more amazed at the extremely low cost!
Cross movement by the table assures maximum precision and accuracy. Powerful heavy-duty 5 hp motor mounted directly on spindle operating on adjustable oilmatic bushings – pressure lubrication – Use wheels up to 4" with cross feed up to 2½" per stroke. These features, plus the unusually sturdy overall construction, eliminate virtually all vibration and insure maximum concentricity. Exclusive BLOHM MICROTIP in-feed and depth-feed control permits automatic fingertip adjustment up to .0002" on cross feed and .0004" in depth feed
PRODUCTION PRECISION PRICE
MASERATI
WESTBURY NEW YORK
Write, Wire or Phone for detailed descriptive literature.

Use postpaid card. Circle No. 245



Loading Funnel For Tumbling Barrels

To speed up loading of tumbling barrels as well as to minimize spilling of materials, Rampe Mfg. Co. has introduced a line of removable funnels to fit all of their tumbling barrels.

The funnels are quickly attached to the opening of the tumbling barrel. Funnels are made for barrels from one gallon to eight cu. ft. capacity. One side of the spout is vertical to permit the use of two funnels side by side on Multiple Unit Barrel Finishers.

Rampe Mfg. Co., 14916 Woodworth Ave., Cleveland 10, O. •

Use postpaid card. Circle No. 109

CLIPPER

PRECISION DIAMOND TOOLS

Industrial Diamonds
Thread Grinders
Turning Tools
Engraving Tools
Dressing Tools
Diamond Powder

Manufacturers of
DIAMOND TOOLS and **WHEELS**

BRANCH OFFICES

CINCINNATI, STEVE URBAN, 1717 Section Avenue

CLEVELAND, BILL WIESE, 8905 Lake Ave.

DETROIT, FLOYD BEARSS, 1433 Northwood Blvd., Royal Oak, Mich.

INDIANAPOLIS, IVAN STRANGE, 33 Tyler Ave., Greenfield, Ind.

PHILADELPHIA, H. J. MILLER, Valley Brook Rd. and Glen Mawr Dr., Ambler, Pa.

ROCHESTER, N.Y., DON GINEGAW, 10 Oak Manor Lane, Pittsford, N.Y.

SYRACUSE, N.Y., BARNES & JORDAN, INC., 409 E. Jefferson St.

Representatives in Principal Cities

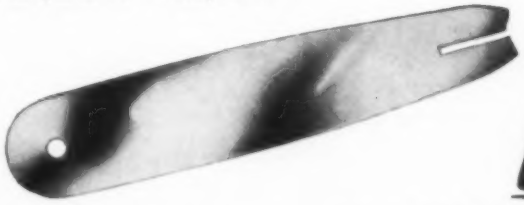
CLIPPER DIAMOND TOOL CO., INC.

345-E HUDSON ST. NEW YORK 14, N.Y.

Use postpaid card. Circle No. 246

HOLDS .001" TOLERANCES BETTER THAN OTHER GRINDERS TESTED... COSTS LESS: PRODUCES MORE

Engelberg's 4-Head, Conveyor-Type, Abrasive Belt Grinder in Operation at Oregon Saw Chain Corporation



Finished to .001" T.I.R. in one pass by Engelberg 4-head, conveyor-type, abrasive belt grinder.

ACTUAL TESTS PROVE

PRODUCTION PERFECTION

After a nationwide tour testing grinders of various makes and kinds, the Oregon Saw Chain Corporation bought an Engelberg #680, 4-head abrasive belt grinder. Improvements in product and production have more than offset the investment, the Company says.

The Engelberg #680 provides through-feed as against the reciprocating feed of the surface grinder. It produces continuously with no down cycles for loading and unloading. And it holds a total-indicator-reading tolerance of .001", better than any other grinder tested. Rejects run less than 1%.

Chain saw bars, heat treated to 42 Rockwell "C" hardness, are finished in one pass. Normal operation calls for the removal of .005" by the four heads at a rate of 10'/min.

ENGELBERG Abrasive Belt Grinders

are available with 1 to 6 grinding heads. Send a sample part for cost-and-time-savings estimate... or an Engelberg Production Engineer will be glad to call. No cost. No obligation.

ENGELBERG

HULLER CO., INC.
323 Seneca St., Syracuse, N. Y.

Use postpaid card. Circle No. 247

continued

TG-12 centerless grinder.

Royal Master TG-12 Centerless Grinder

The new Royal Master Model TG-12 centerless grinder handles work from .004 to 1½ inches in diameter. It may be used for either plunge or thru-feed grinding with conversion to either a matter of minutes. It features increased ease and speed of set up time through greater accessibility to work zone area, rapid replacement of the work wheel, a hydraulic system incorporated for automatic cycling and wheel dressing.

Of great importance to the shop is the fact that machine warmup time has been eliminated through the incorporation of preloaded ball bearings in the spindle design. This feature is very important to small shops and tool rooms that would use the machine intermittently.

The machine, based on initial cost, offers a comparatively low depreciation figure compared to competitive models. Consequently, costly precision lathe work usually employed can be eliminated by finished grinding to the required accuracy. Those requiring the use of diamond wheels may employ a smaller diameter wheel with the TG-12 than with any other models and consequently benefit from a smaller tool room investment.

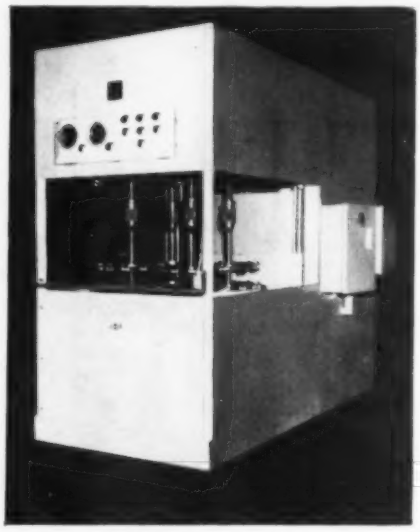
Royal Master, Inc., 111 State Highway 23, Riverdale, New Jersey. •

Use postpaid card. Circle No. 110

New Preplating Finishing Process

An entirely new mechanical finishing process for brass, zinc-base and aluminum die-cast parts preparatory to plating is announced by Grav-i Flo Corp.

The new process, known as Spin-Finish, eliminates hand and automatic buffing. New equipment, using a dry compound, produces, on a multiple



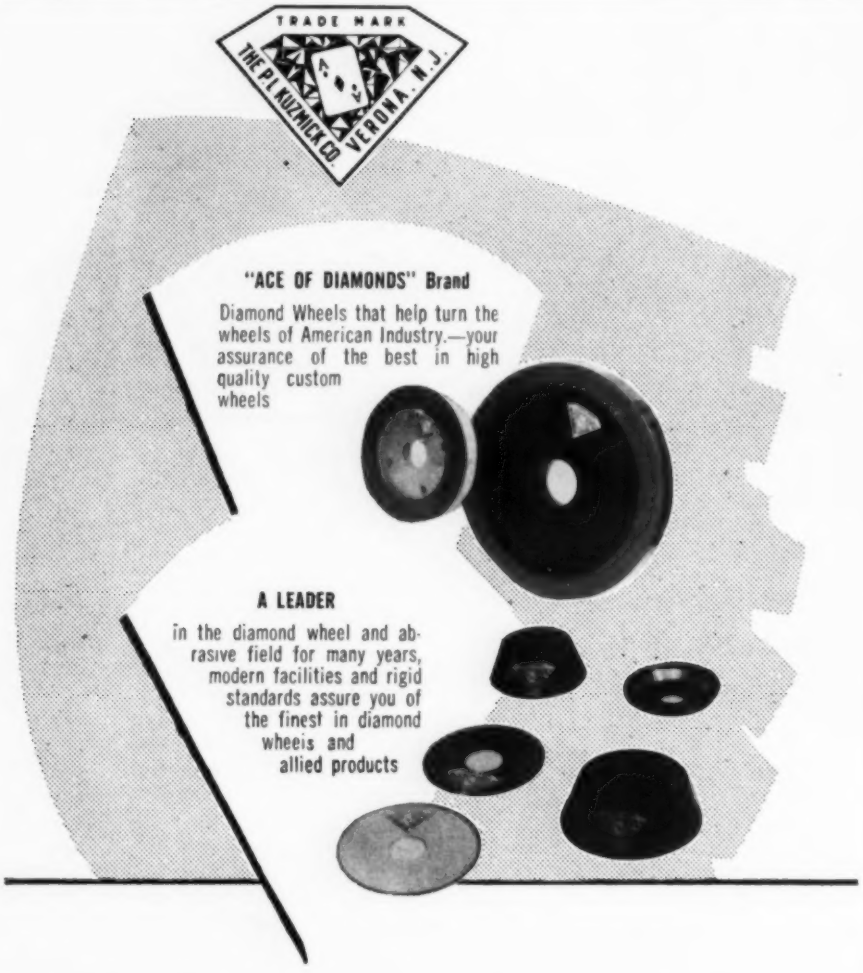
mounting of parts, surfaces and lustre equal to or better than that of older methods.

Fixtures are mounted on four revolving spindles. An automatically timed cycle immerses parts in the compound. Innovation in fixtures permits simultaneous locking and unlocking of parts with a single turn of a cam. Dust-free and fume-free, Spin-Finish eliminates the use of blowers and ventilating systems.

The principle of the new machine, combined with the newly-developed compound, permits finishing parts unusual in shape which under conventional methods were difficult to process or required several separate operations.

Grav-i-Flo Corp., Sturgis, Mich. •

Use postpaid card. Circle No. 111


TRADE MARK
THE P.L. KUZMICK CO. VERONA, N.J.
"ACE OF DIAMONDS" Brand
Diamond Wheels that help turn the wheels of American Industry.—your assurance of the best in high quality custom wheels
A LEADER
in the diamond wheel and abrasive field for many years, modern facilities and rigid standards assure you of the finest in diamond wheels and allied products

PRODUCTS OF OVER 30 YEARS EXPERIENCE

For longer life, cooler cutting and economy of operation, ACE OF DIAMONDS brand Diamond Wheels are the answer to your grinding problems.

Manufacturers of Diamond Wheels and Tools, Powdered Metals and Allied Products

THE PAUL L. KUZMICK CO.

TELEPHONE: CEnter 9-4602 271-279 GROVE AVE., VERONA, N. J.

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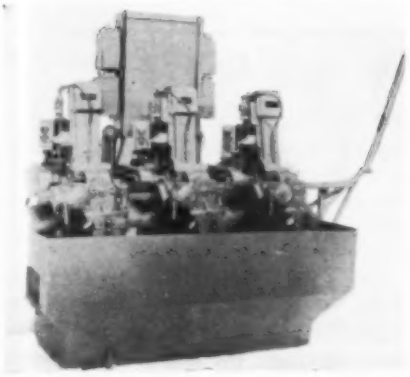


Engelberg Model L4-3 centerless belt grinder.

Engelberg Announces Three-in-one Centerless Belt Grinder

Designed for high-speed volume production of ferrous, non-ferrous, plastic, glass and other materials, this new wet-or-dry belt centerless grinder combines three operations in a single automatic sequence. Through-feed feature permits use of gravity feed hopper for smaller cylindrical parts, which are automatically ejected at opposite end. Accommodating stock from 3/32 to 2-3/4 inch in diameter, any length, this Engelberg Model L4-3 maintains tolerances of .001-inch or less, at through-feed rates up to 35 feet per minute.

Typical grinding sequence, using series of progressively finer-grit abrasive belts, is rough grind, finish grind, and fine polish. The machine is also available with four grinding heads where additional operation such as semi-finish is required. Each head is equipped with individual control panels, and micro-stop size control.

Through-feed rates are controlled by adjustable helix angle of regulating wheel, in combination with change gears which drive regulating wheels at different r.p.m. Abrasive belts are backed by interchangeable resilient contact wheels of varying hardness. Belt speed is 5000 sfpm, and abrasive belts, 4" x 54", can be changed in less than a minute.

Machine's self-contained coolant system applies coolant directly to grinding area and also jet-sprays abrasive belt to prevent belt loading and insure maximum cutting effect.

Individual drive units for grinding heads are 3 or 5 h.p., and regulating wheel drives are 1/15 h.p. Overall machine dimensions, exclusive of electrical control box, are 66" x 35" x 55" high.

Engelberg Huller Co., 831 West Fayette St., Syracuse 4, N.Y. •

Use postpaid card. Circle No. 112

Permanent Magnet Chuck

A new Model 824 permanent magnet chuck has just been announced by the Taft-Peirce Manufacturing Co.

The 824 features 100% all-over holding power and a unique concept in faceplate construction. Special Alnico V chuck design has eliminated all dead spots and provides full edge-to-edge useable surface. Actual magnetic power has been increased 28% over comparable units. The new style faceplate uses a special epoxy resin, non-magnetic separator material which provides unusual faceplate stability and makes the chuck 27% lighter, it is said. In addition, these new separators eliminate wheel loading while dressing, and the chuck can be readily used for fine tolerance work.

Specifications of the new 824 include height of only 2-7/16", work surface 8" x 24", magnetic surface of 168 sq. inches; and weight of 110 lbs.

Taft-Peirce has shop-tested the new 824 and found that problems with residual magnetism have been eliminated. Workpieces can be moved on and off quickly and easily and it is suitable for handling a wide variety of work, including grinding, light milling and shaping. The 824 can also be gauged for handling extra large pieces.

The Taft-Peirce Manufacturing Co., Woonsocket, R.I. •

Use postpaid card. Circle No. 113

WALKER makes a complete line of Demagnetizers, including the portable shown here. This demagnetizer is particularly well adapted for removing residual magnetism by rolling the unit slowly along the work. Other types are available, including hollow core demagnetizers.

WALKER Demagnetizers are compensated so that the magnetic flux increases as iron comes into the demagnetizing field. They can be arranged for production line by passing endless belt through aperture to carry work pieces.

Made by the originators of the magnetic chucks

O. S. WALKER CO. Inc.

WORCESTER 6, MASSACHUSETTS

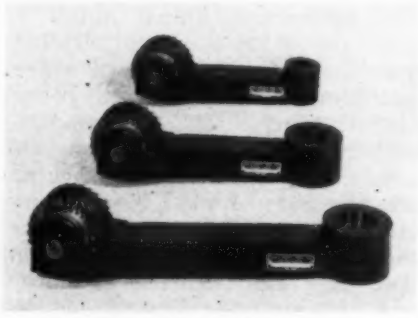
Original Designers and Builders of Magnetic Chucks

Use postpaid card. Circle No. 249

continued

Ball Bearing Wheel Dresser For Blanchard Grinders

The Aer-O-Matic Tool Co. announces a dressing attachment for all types of Blanchard grinders. The complete dressing arm is manufactured from steel, eliminating possibility of arm breakage due to stress. The dresser cutter assembly is held in place with removable clamps so that the entire spindle assembly can be quickly removed for replacement and a new assembly mounted. In this manner also, the spindle shaft is held securely in place, preventing any moving parts to come in contact with the arm causing arm wear, often is found in using loose pin or loose cutter type dressers.



Aer-O-Matic ball bearing dressers for Blanchard grinders.

Because of the rigidity of the dresser arm and cutter assembly, there is no "dig and bounce," assuring flat ringwheels and segments, with less abrasive needing to be removed per dressing. Holes dug into the cutting surface of the wheel are completely eliminated. The rounding of outer wheel edges and the breaking down of segment lead edges are prevented.

Due to the cutter assembly's greater width and its even contact with the wheel or segment, the percentage of sharp abrasive presented to the parts being ground is more than doubled, reducing machine power load. Dressing arms shown are for the no. 11 and no. 18 Blanchard machines.

Aer-O-Matic Tool Co., 5059 W. Diversey Ave., Chicago 39, Ill. •

Use postpaid card. Circle No. 114

Abrasive Belt Bench Grinder

The Curtis Machine Division of The Carborundum Company has announced the addition of the new Model DBA-O Bench Grinder to their line of abrasive belt machines. The 6" diameter, 2" wide contact wheel is driven by a .6 HP motor developing a speed of 5100 S.F.M. By use of direct drive of the contact wheel there is no loss of power or speed of the abrasive belt. Applications include grinding, polishing and deburring. The idler arm incorporates belt tracking and tensioning mechanisms and can be rotated 360° around the spindle to provide operation in any position. The standard

abrasive belt size is 2" wide by 48" long.

For squaring, chamfering, and beveling, a platen attachment is available at a slight additional cost. This platen is attached directly to the idler arm and maintains its relationship to the abrasive belt without adjustment regardless of the position of the arm. Form A-1386 describes unit.

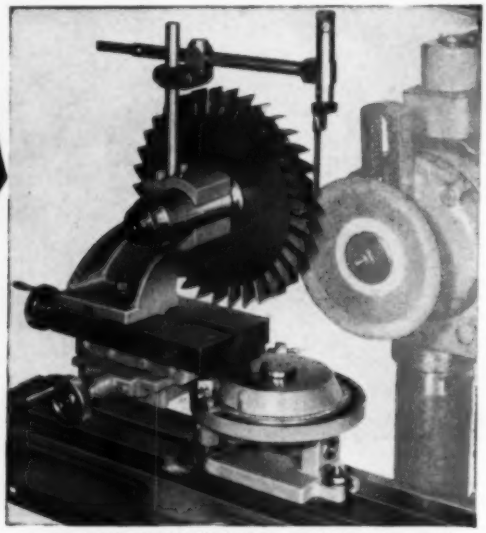
Curtis Machine Div., Carborundum Co., Jamestown, N.Y. •

Use postpaid card. Circle No. 115

THE UNIVERSAL RADIAL CUTTER GRINDING FIXTURE

Does 5 Operations without removing cutter from its ARBOR!

On cutters up to 8" in diameter, the No. 6 fixture, as shown with our No. 6A heavy-duty, right-angle, ballbearing spindle workhead:
Sharpens side teeth on **both** sides.
Sharpens peripheral teeth.
Generates small or large radii on **both** corners of each tooth.
(Other workheads available)

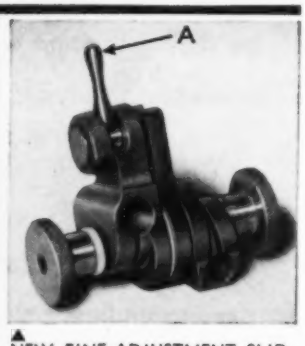


▲ THESE DEPENDABLE GRINDING FIXTURES SAVE THE LIFE OF YOUR CUTTERS. Write for our catalog 603

◀ UNIT 1A
This Universal Cutter Grinding Fixture fits any universal tool or surface grinder.

Radial Grinding Attachment D combines with Unit 1A for sharpening end mills with square, conical, or ball nose shapes. ▼

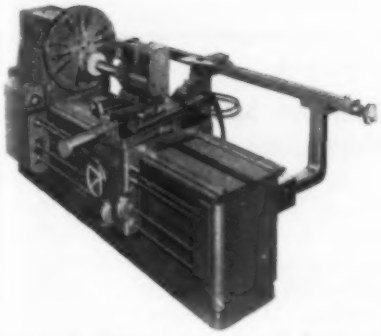
▲ UNIT 4A
Radial Grinding Fixture for sharpening fluted end mills with square, conical, or ball-nose mills. The index disc provides for multi-flute cutters.



▲ NEW FINE-ADJUSTMENT SLIDING SWIVEL GIVES SMOOTH, PRECISE INDICATOR SETTING. Smooth, positive positioning of finest dial indicator is readily accomplished by the fine-adjustment Sliding Swivel. Final precise positioning is accurately made by slight movement of convenient lever "A".
WRITE FOR:
SLIDING SWIVEL FOLDER

ROCHELEAU TOOL & DIE CO.
650 North Main St., Leominster 1, Mass.

Use postpaid card. Circle No. 250



Tracer controlled grinder employs Turchan follower, radiused wheel.

Tracer Controlled Contour Grinder

Equipped with standard flat wheels dressed to very simple radii, intricate contours, both internal and external, are ground automatically on a contour grinder recently developed by the Industrial Tool Engineering Company of Detroit. Variable speed work head also makes polishing and buffing possible.

The problem of maintaining accurate contact between the tracer stylus and the template required months of experimenting on a wide variety of work pieces. In accomplishing this, Industrial designed a contour grinder with 3 angularity adjustments in a single swivelling or pivoting unit.

A swivelling grinder spindle was mounted on the tracer slide. This grinding spindle will swing in a 180° arc.

The tracer slide was mounted "turret-wise" on the carriage and is free to swivel 110° with the tracer stylus. The tracer stylus also swivels (180°) and is mounted on the end of the tracer slide. With this combination of "angularity control" Industrial's new contour grinder will maintain precise contact pressure between the Turchan tracer stylus and the template.

Thus precise and automatic grinding of contours inside or outside are possible through hydraulic tracer control. Tracer slide and carriage are both driven by hydraulic tracer control.

The head stock range is from center to 39 inches on O.D. work and being equipped with heavy duty bearings will carry work pieces weighing over a ton.

Standard 3½ to 8-in. diameter flat grinding wheels are used by simply dressing them to the radius of the template in use.

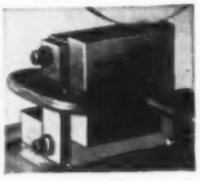
Spindle speeds of the new machine offer a wide range on the work head from 0 to 220 RPM and on the grinder head of 3,450 RPM (rated).

Industrial Tool Engineering Co., 13849 Keal, Detroit, Mich. •

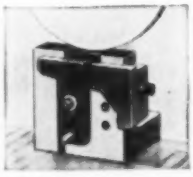
Use postpaid card. Circle No. 116

LASSY MASTER V-BLOCK ANGLE PLATES

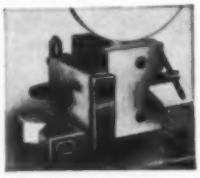
This Master V-Block Angle Plate is an improved new design. Saves hours of setup time. Assures precise work accuracy. Requires less skill.



Side Gage automatically squares work precisely and without removing angle plate from chuck. Repetitive accuracy maintained.



Adjustable parallel holds the smallest work for position and clamping with ease and accuracy



LASSY MASTER Angle Plate provides a master setup for regrinding of worn or inaccurate Angle Plates.

WRITE FOR DESCRIPTIVE LITERATURE

LASSY TOOL COMPANY

PLAINVILLE, CONNECTICUT, U.S.A.

Use postpaid card. Circle No. 251

WALLS TU-WAY BELT SANDER

Full 1/3 h.p. G. E. Motor

USE IT EITHER WAY

At last, a top quality industrial sander that provides all the most wanted features — yet sells for so little.

complete with cord, plug, switch ready to use $89.95

Illustrated Literature on Request

A few desirable distributor territories still available.

WALLS SALES CORPORATION

333 Nassau Avenue Brooklyn 22, N. Y.

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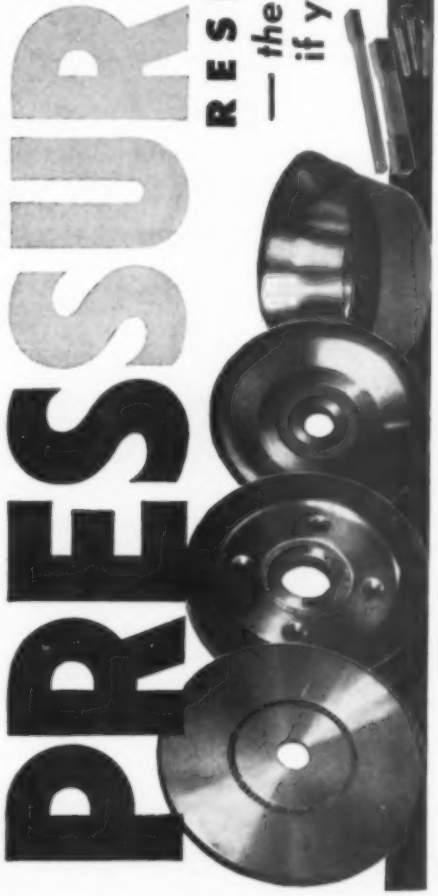
PRESSURE-LOK® -224

RESINOID DIAMOND WHEELS

— the best diamond wheel bond ever developed — if you've used them - you know they're best! if you haven't - let us show you!

UNITED STATES DIAMOND WHEEL CO. AURORA, ILL.



Use postpaid card. Circle No. 253

continued

Hammond Polishing Lathe Now Has Braking Bar

The Hammond Model VRO variable speed polishing and buffing lathe can now be furnished with a special braking bar. Machines with a single brake handle are still available, but this special brake bar allows the operator on either side of the lathe to actuate it. This is an extra safety feature and a convenience. This also allows a man on a "sit-down" operation to operate the brake without rising, and either operator can do it.

The VRO variable speed polishing and buffing lathe is a heavy duty production machine with spindle speeds infinitely variable between 1500 and 3000 RPM. Speed is changed by turning speed dial on top of the machine.

Hammond Machinery Builders, Inc., 1614 Douglas Avenue, Kalamazoo, Michigan.

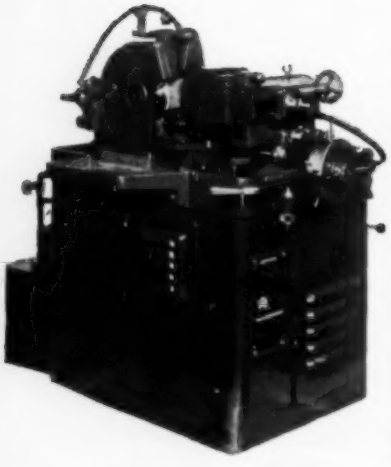
Use postpaid card. Circle No. 117

LOW COST GRINDERS

RIBON UNIVERSAL GRINDERS

Electro mechanical and hydraulic models produced by one of Europe's largest grinder manufacturers—completely universal with swinging internal grinding heads. 14" x 2" x 5" O.D. wheel with 3 H.P. and 18000 and 35000 I.D. spindles with 1½ H.P. Long conical adjustable plain bearings in both wheelhead and workhead with automatic pressure oil bath lubrication. All machines have automatic table traverse and infeeds.

11"x20" Electro Mechanical Grinder	$3450.00 fob N.Y. or Chgo.
11"x32" Electro Mechanical Grinder	$3650.00 fob N.Y. or Chgo.
11"x42" Electro Mechanical Grinder	$3850.00 fob N.Y. or Chgo
12"x20" Hydraulic Plunge Cut Grinder	$5950.00 fob N.Y. or Chgo



CENTRI CENTERLESS GRINDERS

Close tolerance production units capable of .0001" tolerances in production. Long conical adjustable plain bearings on both grinding wheel and feed wheel spindles with pressure oil bath lubrication. Equipped for bar feed, thru feed, and infeed work with automatic ejectors and automatic cycling on infeed where desired. Diamond or crush dressing on both wheels with contour form and taper dressing of wheels by either hand feed screw or hydraulically.

MODEL 0 Work diameters .012"-⅝" ($1950.00 fob N.Y. or Chgo.) 10x2½x5 wheel with 2½ H.P.

MODEL 1 Work diameters .016"-2" ($3450.00) 12x4x5 wheel with 7½ H.P.

MODEL 3 Work diameter .030"-3" 16x8x5 wheel with 16 H.P. Hydraulic Dressing of wheels and hydraulic automatic Variable cycling for infeed ($6475.00)

THE AMERICAN HERFORDER CORP.
1801 W. COLUMBIA AVE. CHICAGO, ILLINOIS

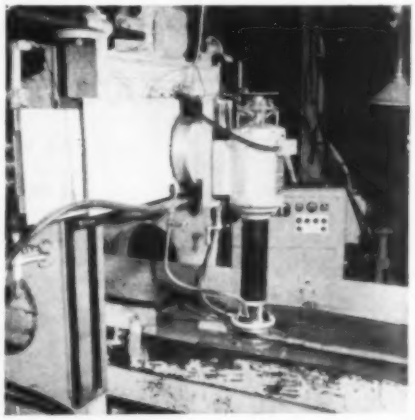
Use postpaid card. Circle No. 254

Standard Spindles Usable for Electrolytic Grinding

The Standard Electrical Tool Co. announce that all of their Super Precision Spindles, whether motorized or independent drive, are available with accessories to serve electrolytic (grinding) metal removal.

Installation view shows that with stainless steel aircraft honeycomb positioned on the planer bed, the motorized grinding spindle with 5 HP motor at 3600 RPM accommodates a 6" diameter metal plate wheel impregnated with abrasive or diamond particles.

Electrolytic metal removal involves the assembly of a (brush) slip ring on the back of the spindle for carrying the direct current through the spindle to the wheel, the wheel acting as the cathode, while the work piece represents the anode. Assembled on the wheeel end of the spindle is a sprinkler-spider, of circular design with hose connection for spraying the electrolytic solution at the perimeter of the wheel. The wheel holder has an integral circular well with tangent holes arranged to carry the electrolytic solution in the wheel recess, both delivering a flooding of the work area.



Stainless honeycomb machined with electrolytic Standard spindle.

The direct current necessary for electrolytic metal removal passing through the spindle is completely isolated with an individual design developed by this spindle manufacturer. This isolation eliminates pitting of ball bearings and assures efficiency and longevity of ball bearing performance. Isolation allows the direct current to be transmitted through a motorized alternating current spindle with maximum efficiency.

A wide variety of Spindles is available to serve most every type of machine tool conversion.

Standard Electrical Tool Co., 2488-96 River Rd., Cincinnati 4, Ohio.

Use postpaid card. Circle No. 118

New Vertical Type Production Honing Machine Developed by Superior

A new vertical type production honing machine with a capacity up to 4 inches in diameter and 12 inches in length has just been announced by Superior Hone Corporation.

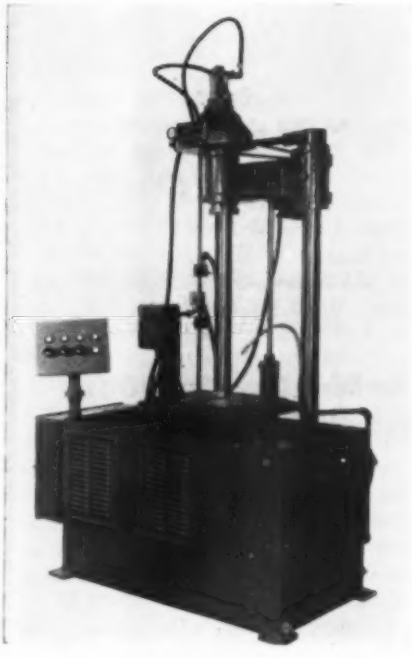
The speed of the V-belt driven spindle is infinitely variable from 225 to 550 rpm by means of a knob on the drive head. Adjustable limit switches control and set stroking lengths. Jogging switches on the control panel permit working in any desired section of the part without resetting the limit switches. The honing cycle is controlled by an electronic timer adjustable within a range of 6 to 120 seconds.

The ground table is adjustable four ways for squareness. The 3-inch ground guide bars are mounted to the fabricated steel base which houses the coolant reservoir, pump and oil filter tray as well as the hydraulic reservoir and pump.

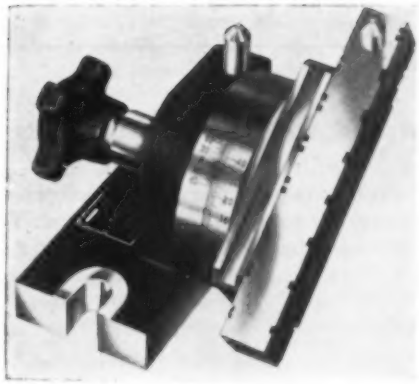
The driving head, mounted to the bars with bronze bushings, is hydraulically controlled for stroking and constant pressure on the stone expansion. Stone pressure is controlled and set by a regulator valve and pressure dial. The integrally sealed driving head spindle bearings require no lubrication.

Superior Hone Corporation, 1637 Elreno Street, Elkhart, Indiana. •

Use postpaid card. Circle No. 119



Superior Model VA vertical honing machine.



Angle Dresser and Tool Holder

A new tool combines the function of two tools, an angle dresser and tool holder. Called the Rothfuss G-2 angle dresser and tool holder, it is currently being introduced by the Rothfuss Tool Co. The G-2 has an easy to read vernier scale 0° to 180° guaranteeing accuracy within 2 minutes. Priced at only $87.50 including the cutting diamond.

Rothfuss Tool Co., Box 2804, Providence 7, R.I. •

Use postpaid card. Circle No. 120

Movie—Low Cost Jig Grinding

A ten minute, sound movie, "Low Cost Jig Grinding," demonstrates the technique of jig grinding by means of Vulcanaire power tools used in connection with jig borers. Other applications, such as high speed precision grinding on lathes, milling machines, boring mills and other special setups are included in the presentation.

Available to any interested group through the Vulcan Tool Co., 730 Lorain Ave., Dayton 10, O. •

A BETTER BACK-UP WHEEL

R57

FOR YOUR ABRASIVE BELTS

45° scoop tooth used for aggressive stock removal

AVAILABLE NOW IN POPULAR 14" DIAMETER SIZES AT BIG SAVINGS

You can get the new R-57 RUBBER CONTACT WHEELS at lower prices in 14" DIAMETER sizes **due to newly developed production techniques. These new wheels have all the well-known features of the R50 and R-54 models.—LONGER BELT LIFE . . . OIL RESISTANT RUBBER . . . WET OR DRY OPERATION . . . HEAT DISSIPATION . . . MAXIMUM SAFETY . . . other features. And what's more these wheels have a 30% trade-in value.

**The new R57 and the R50 and R54 contact wheels are available in many popular sizes . . . ½" to 22" DIAMETERS in WIDTHS from 1" to 6". Other wheels made to your specifications in all widths and diameters.

14"

TYPE	WIDTH OF FACE 1"	2"	3"	4"
PLAIN	32.00	34.00	36.00	38.00
SERRATED	37.00	39.00	42.00	44.00

AVAILABLE IN PLAIN OR SERRATED FACE IN ALL DUROMETERS

A WHEEL FOR EVERY OPERATION

Slit Serration — Aggressive Contact Work
45° Standard — Stock Removal
"X" Serration — Moderate Contour Wheels
Cosmo Expander Backstand Idler Not Needed

DElta 6-8900

CHICAGO RUBBER COMPANY, INC.
651 MARKET STREET • WAUKEGAN, ILLINOIS

Specializing in Contact Wheels and Industrial and Printers Rolls

Use postpaid card. Circle No. 255

continued

Redesigned Centerless Lapper

The Model 200 centerless lapping machine, introduced several years ago by Size Control Co., Chicago, has been changed in several respects to improve the lapping action.

The redesigned cabinet features a stainless steel top and heavier, sturdier over-all construction. Steel pans under each set of lapping rolls prevent small parts from being accidentally dropped into the bottom of the cabinet and permit wet lapping.

Spacing between lapping rolls may now be adjusted easily and quickly to accommodate the various sizes to be lapped. Range of diameters is .010" to 10.000".

Because many lapping machine operators prefer to sit at the machine, special screws in the rear legs of the cabinet are adjustable, permitting the lapper to be tilted at various angles toward the operator.

Two new accessories are now available for the centerless lapper—a roll dresser which keeps the lapping rolls in top-notch condition and a hold-down attachment for the piece parts.

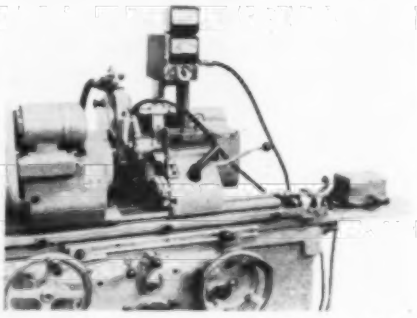
Bulletin L-56, Size Control Co., 2500 W. Washington Blvd., Chicago 12, Ill. •

Use postpaid card. Circle No. 121

Computer for Control of Grinder

Based on a new electronic principle which permits automatic computation without sacrificing gauging accuracy, the LI-AP Autopairer automatically controls any grinder to produce external pieces to fit bores within limits of desired radial play. Accuracy can be guaranteed down as low as .000040", regardless of the type of grinding machine.

The device eliminates the necessity for match gauging or selecting fits. The unit also dispenses with the necessity of making the usual mechanical settings on a grinder or resetting for wheel wear. Backlash is electronically compensated.



"Autopairer" controls grinding of O.D. to match mating bore.

The finished bores are placed on the I.D. gauging anvil one by one. If necessary, when unwieldy large pieces are involved, they can be inserted in the I.D. gauge, which may be located up to 5 feet away from the grinder. The rough stem, or work piece, is then placed in grinding position, whereupon it is automatically ground to fit. No gauge readings are necessary.

The I.D. attachment can be disconnected, converting the unit into an L-1 Autosizer for grinding a series of pieces all to an identical size within guaranteed tolerances.

EAM Division, Industrial Gauges Corp., West Englewood, N.J.

Use postpaid card. Circle No. 122

Dearborn Gage Now Offers Multiple-Column Instruments

A new standard line of multiple-column air gaging instruments which rapidly check a number of close-tolerance surfaces at the same time is announced by the Air Gage Division, Dearborn Gage Co.

According to the manufacturer, the multiple-column arrangement of this equipment permits the accurate and simultaneous measurement of up to

Handiest Tool in the Shop
JEWELOX READY ROLL
READY ROLL
JEWELOX READY ROLL
At your finger tips for metal working jobs . . . fifty yards of super-keen abrasive cloth tightly wound on a metal spool, full 1" arbor . . . in widths of ½", ¾", 1", 1¼", 1½", and 2" . . . all standard grain sizes from 24 to 400.
Hang up in convenient spot, yet out of the way . . . always ready for immediate use. Simply tear off strip of desired length. Popular for grinding, finishing, polishing hard to reach places . . . also for short jobs or odd jobs.
JEWELOX abrasive grains are sharp and tough. Its specially woven cloth backing is processed for extra strength. Each roll packed in strong, attractive carton. 10 ready-rolls to a standard shipping unit. For complete details write Abrasive Products, 517 Pearl Street, South Braintree 85, Mass.
Abrasive Products, Inc.
SOUTH BRAINTREE 85, MASSACHUSETTS • MAKERS OF JEWEL COATED ABRASIVES

Use postpaid card. Circle No. 256

Dearborn multiple-column air gage.

eight separate dimensions, with gage response within five-tenths of a second.

The new offering, it is pointed out, can include instruments with any number of columns required for a given application—but in cases where purchasers wish to fabricate their own gaging fixtures rather than to have them included with the order, stock delivery is available in standard instruments ranging from two-column to eight-column multiples.

Major features of this new Dearbornaire line include a new, self-cleaning pressure system, complete linearity over the full scale, interchangeable component parts, two-step amplification conversion, and zero-centered scale permitting tolerances to be read as plus or minus from the nominal dimensions.

Air Gage Div., Dearborn Gage Co., Dearborn, Mich. •

Use postpaid card. Circle No. 123

Tissue and fluid dispensing unit for lenses.

Lens Cleaning Station

Unit simplifies cleaning the lenses of protective eyewear. Grey-green in color, the attractive dispenser, 9" x 15½" x 4", is made of heavy gauge steel. A plunger-type spray top 8 oz. bottle, provides anti-fogging lens cleaning fluid. Single optical tissues 5" x 9" are dispensed from two separate positions and a receptacle for used tissues is provided. Unit is serviced through the front by a key lock which also prevents tampering. Screws are included to attach to wall for permanent installation.

Lens cleaner for refills is available in pints and gallons. Optical tissues 5" x 9", 240 tissues per box, are available by the case, containing 72 individual boxes.

United States Safety Service Co., 1215 McGee St., Kansas City, Mo. •

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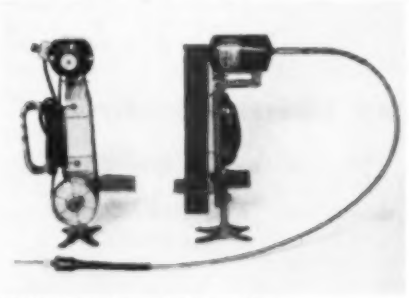
Portable-Stationary Sander

The Malco Sandman direct drive belt sander may be set up as a stationary sander, yet quickly released for use as a portable unit. The Sandman may be used for metal, wood, plastic and stone. It grinds and drills, sharpens tools, drills and bits and sands vertically, diagonally or horizontally.

List price is $25.95 complete with motor. Flex shaft (extra) with ⅛" chuck is a valuable accessory for grinding and drilling.

The Malco Co., 580 South Alameda St., Los Angeles 13, Calif. •

Use postpaid card. Circle No. 125



Malco Sandman belt sander.

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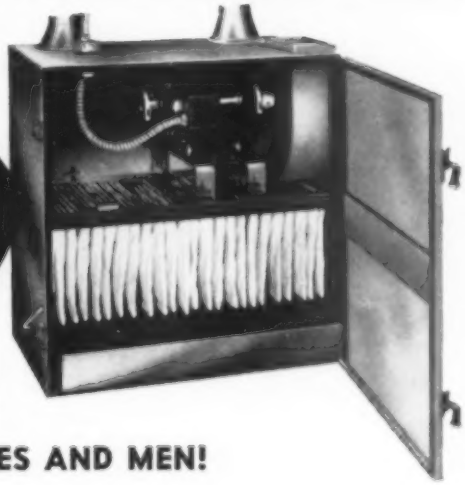
STOP SHOP DUST
IN ITS TRACKS!

WITH THE EQUIPMENT THAT *FIGHTS* IMPURE AIR IN INDUSTRY.

THE CINCINNATI AIR MASTER



THE ANSWER TO DUST, GRIT, GRIME THAT DOOMS MACHINES AND MEN!

GRINDING
BUFFING
POLISHING
DE-BURRING

Metal and wheel grit from grinding, buffing, polishing and deburring is trapped by Airmaster instantly, filtered out by fabric and steel wool bags. Only clean air, grit-free and safe for both men and machines, is discharged. Rugged construction and simplicity of design has made the Cincinnati AIRMASTER famous.

Featured nation-wide by leading distributors. Write for catalogue TODAY!

Makers of a complete line of pedestal and bench grinders and buffers, speed lathes, dust collectors and cut-off machines.

THE CINCINNATI ELECTRICAL TOOL CO.
314 MT. HOPE AVE. • CINCINNATI 4 • OHIO

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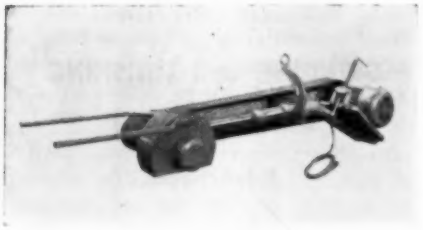
continued

Swing Frame Buffer for Large Irregular Castings

The United States Electrical Tool Company has developed a new swing frame type buffer which has been highly successful in buffing large aluminum castings to a high polish where semi-automatic or automatic equipment cannot be used because of size or irregularity of casting.



The buffer is available in various models ranging from 5 to 15 HP and to accommodate buffing wheels up to 24″ diameter and 6″ face.

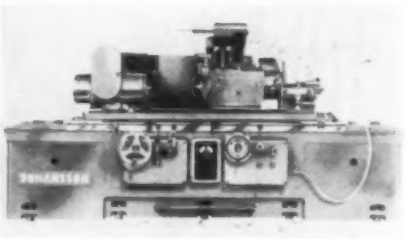
U.S. Electrical Tool Co., 3640 Llewellyn St., Cincinnati 32, O. •

Use postpaid card. Circle No. 126

New Johansson Grinders

Homestrand, Inc., Larchmont, New York, have announced a new precision grinder, the Johansson Grinder, a Swedish high quality product.

It is available in two types, the 2P for production, and the 2U for tool-room and production use. Center distances are 40″, 60″ and 80″, and the swing over table, 14″.



Johansson 2U universal grinder for tool-room, production use.

The universal type takes grinding wheels of 20″ diameter and up to 3″ width, whereas the production model takes up to 30″ and 4″ diameter. The table travel is up to 236″ per minute. The maximum diameter in chuck is 7″; in collets, 1½″. The headstock is gearless. There are 12 speeds, ranging from 20-320 RPM.

The wheel head swivels to allow simultaneous diameter and end face grinding by profiled wheels. The head stock is rotatable through 360° and can be used at either right or left hand end of the table.

The manual and automatic feeds may be operated simultaneously. Consequently, any diversion from the true dimension, due to wear of the grinding wheel when grinding a series of work pieces, can be adjusted without releasing any stops.

For series production, the machine can be equipped with an electrical, hydraulic attachment which automatically switches from normal rate of feed to fine feed at a predetermined point.

At the end of the fine feed period, a predetermined finishing run is initiated, after which the grinding support automatically returns to its original position.

The standard dressing attachment enables the wheel to be dressed without removing the work piece.

Homestrand, Inc., 9 Addison St., Larchmont, N.Y. •

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GET GREATER GRINDER PRODUCTION
BETTER SURFACE FINISHES
LOWER PRODUCTION COST

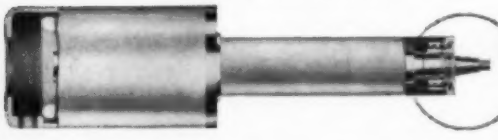
From all your Surface Grinders, new or old

Specify POPE HEAVY DUTY, MOTORIZED SPINDLES

POPE 1, 2 and 3 HP, 1800 or 3600 RPM Surface Grinder Spindles:

- assure continuous production of accurate parts.
- revolve accurately under the heaviest loads.
- permanently lubricated (Pope System) for the life of the bearings.
- have the rigidity to support diamond wheels and to produce more good work.
- have the extra rigidity for crush dressing and form grinding.

WRITE FOR PRICE AND DELIVERY.



LOOK AT THE BEARINGS! permanently preloaded

These super-precision, double row cylindrical roller bearings have the capacity to assure smooth, chatter-free operation over a long life — give the Spindle the ability to rough off surplus metal fast but maintain its inbuilt precision for producing fine finishes.

Separate super-precision ball thrust bearings eliminate endwise movement of the shaft in either direction.

No. 117

POPE® ENGINEERS AND BUILDS STANDARD AND SPECIAL PRECISION ANTI-FRICTION BEARING SPINDLES FOR EVERY PURPOSE

POPE MACHINERY CORPORATION • 261 RIVER STREET • HAVERHILL, MASS.
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News of Industry

Carborundum Divisionalization Continues—Appoint Five New Vice Presidents

Carborundum's board of directors recently elected five vice presidents—**Niles C. Bartholomew, Gene DeMambro, I. Wendell Hamm, Joseph S. Imirie,** and **Leslie E. Simon,** according to an announcement by Clinton F. Robinson, president of the company.

Bartholomew, formerly vice president of the subsidiary Carborundum Metals Co., Inc., which manufactures reactor materials zirconium and hafnium, was elevated to vice president of the parent company and will continue as general manager of Carborundum Metals Company now designated a division of the company. The division operates a plant in Akron, N.Y. and is now building an additional plant in Parkersburg, W. Va. to more than double present zirconium production.

DeMambro, since 1946 president of Curtis Machine Corp. which manufactures abrasive belt machines in Jamestown, New York, continued as its president when it was made a subsidiary of Carborundum in 1955. Curtis Machine is now designated a division of The Carborundum Co. and DeMambro, now promoted to vice president of The Carborundum Co., will be in charge of the division as its general manager.

Hamm as a vice president of the company will continue to direct the activities of the Manufacturing Div. of the functional staff which coordinated plant modernization, expansion and related activities of the subsidiaries and operating divisions of the company, now programmed at $30,000,000 for 1957 and '58.

Newly elected vice president Imirie will continue as general manager of the Electro Minerals Div. which manufactures and markets crude abrasives, abrasive grain and powders, tumbling nuggets, metal additives, and other electric furnace products.

Vice president Leslie E. Simon (Major General U. S. Army, Retired) who came to Carborundum in January 1956 as director of research and development will continue as director of this rapidly growing division which has its central laboratories in Niagara Falls, N.Y.

General Robinson said the five executives were elected vice presidents in recognition of their outstanding performance. As vice presidents they will be officers of the parent company and as general managers or directors they will continue to be directly responsible for the operation of their respective divisions. Thus divisionalization and central control of the business are both strengthened by their promotions to vice presidents of The Carborundum Co. •

Norton Acquires Brazilian Abrasives Plant

Norton Company has acquired a controlling interest in Abrasivos Irmaos Meyer, S.A. of Sao Paulo, Brazil. The firm manufactures coated abrasives, grinding wheels, and abrasive grain. The announcement was made by A. Donald Kelso, vice president in charge of Norton's foreign operations and president of Norton Behr-Manning Overseas, Inc.

The Brazilian Company consists of several plants including mining rights at a bauxite mine, an electric furnace plant at Belo Horizonte, 300 miles north of Sao Paulo, a new grinding wheel plant at Guarulhas, a suburb of Sao Paulo, an office and several other smaller buildings in Sao Paulo. •

Here's an interesting Idea-Book for you!

NEW!

Sundstrand Magnetic Chuck Catalog for Grinders

Manufacturers and owners of grinding machines will both find many time-saving and profitable work holding ideas in this new 12-page book.

Simplification of set-ups, powerful holding of heavy work plus many other features are included. Write for your copy today. Ask for Bulletin 377-M.

SUNDSTRAND POWER-GRIP ®

SUNDSTRAND
Magnetic Products Co.
Division of Sundstrand Machine Tool Co.
1020-9th ST • ROCKFORD, ILLINOIS

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continued

GM Research Promotions

Three promotions on the Research Staff of General Motors were announced today by Dr. Lawrence R. Hafstad, vice president in charge of research. All are effective March 1.

John M. Campbell, who has been Technical Director since 1954, was named Scientific Director, and in this newly created position will serve as Dr. Hafstad's principal assistant.

Arthur F. Underwood, who has headed the Mechanical Development Department, was elevated to manager of Research Staff Activities. **Gregory Flynn, Jr.,** succeeds Mr. Underwood.

The promotions result from the retirement March 1 of Alfred L. Boegehold, manager of Research Activities and principal assistant to Dr. Hafstad. Boegehold will continue as a consultant to Research Staff following his retirement. He is a veteran of 36 years with GM. •

43 Nations Now In U.S. World Trade Fair

Eleven more nations have announced their entry into the United States World Trade Fair, bringing the present total of participating nations to forty-three, according to Charles Snitow, Fair president. The U.S. World Trade Fair will be held at the New York Coliseum, April 14-27.

The eleven (11) countries responding to President Eisenhower's invitation to participate in the first United States World Trade Fair are: Argentina, Cambodia, Nationalist China, Czechoslovakia, Liberia, Mexico, Panama (Colon Free Zone), Poland, Philippines, Spain and Tunisia.

In inviting foreign nations to participate in the largest display of goods, products and services ever presented in the Western Hemisphere, President Eisenhower said: "The U.S. World Trade Fair offers the world's businessmen a common marketplace in the Western Hemisphere. More than this, it is a practical demonstration of the economic inter-relationship of nations through the exchange of goods and services. It is the American people taking another step to improve political and economic conditions throughout the world and it emphasizes again the basic drive and aim of the United States Government." •

New Armour Sales Manager

The Coated Abrasives Division of Armour and Company, Alliance, Ohio, announces the appointment of three new sales supervisors, **Robert G. Gallaway, George D. MacMillan, and Eugene F. Land.**

Mr. Gallaway will headquarter in Columbus, Ohio; Mr. MacMillan in Baltimore; and Mr. Land in Rockford, Illinois. •

Albertson & Company, Inc. Opens New Abrasive Plant

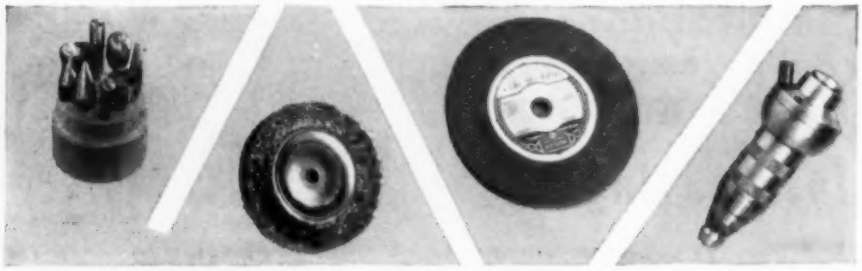
Albertson & Company, Inc., Sioux City, Iowa, have opened a new plant in LeMars, Iowa, for the production of Sioux Abrasive Discs.

The new 125 ft. x 200 ft. windowless plant is air conditioned, winter and summer both for working comfort and for better quality control of the discs, which are affected by temperature and humidity variations.

Albertson manufactures abrasive discs in five, six, seven, and nine inch diameters, coated with grits ranging in coarseness from No. 16 to No. 150. Production methods are exclusive with Albertson & Company, and much of the equipment is company designed and built. •

Norton Detroit Appointments

Norton Company has announced the appointment of a field engineer and two abrasive engineers in the Detroit area. **William Pettigrew** has been named field engineer. He was formerly an abrasive engineer. **Russell J. O'Neil** and **Lincoln M. Johnson** have both



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from start to finish

Remember, when you're checking specifications and selecting equipment, don't fail to consider Haskins flexible shaft machines and accessories. Haskins' complete line of equipment insures faultless performance on your *special* and *standard* metal-working operations —*without interruptions.*

Whether you're grinding, wire-brushing, filing, whatever the job, a start with Haskins will carry you through from the beginning right down to a perfect finish. Our three models, bench, pedestal and suspended mounts, plus a multiplicity of metal-working tools, enable you to achieve faster production, lower labor costs and a superior finished part! Find out about the versatile line of Haskins flexible shaft machines and accessories—*leaders in their field for over 30 years.*

Write Today for a Catalog and Literature

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been appointed abrasive engineers, covering accounts in Metropolitan Detroit. Both were formerly field engineers. •

Perks Elected Norton Treasurer —Norton 1956 Sales Total $172 Million

William H. Perks was elected treasurer of Norton Company on January 15th at the 72nd annual stockholders meeting succeeding **Edwin E. McConnell,** who is retiring.

Perks is also controller and a director of Norton Company. He will retain these positions in addition to his duties as treasurer.

George N. Jeppson was re-elected chairman of the board of directors and **Milton P. Higgins** re-elected president of the company by the directors. In his annual report, Higgins said the company had an excellent year in 1956 with sales from all divisions totalling $172,000,000—highest in Norton history. •

Jones & Lamson Opens Boston Office

Jones & Lamson Machine Company of Springfield, Vermont announces the opening of a Boston District Office located in the Professional Building at 751 Main Street, Waltham 54, Mass. This office will be responsible for the sales and service of Jones & Lamson machine tools and optical comparators in Massachusetts, Rhode Island and Connecticut with the exception of Fairfield County and part of New Haven County. The State of Vermont and the portion of New York State, including the Schenectady area and the eastern counties north of Schenectady, will also be handled by the new office.

John H. Hinchliffe will be District Manager of the new office, in addition to being in charge of the Eastern Massachusetts territory for the Machine Division and the Optical Comparator Division products.

George F. Bickford of North Grafton, Massachusetts will be Field Engineer for comparators and grinders in Rhode Island, Eastern Massachusetts and the Connecticut area serviced by the Boston office.

Robert DeCook will be Field Engineer for turret lathes, Fay lathes, grinders and optical comparators for the Schenectady, Vermont and New York State areas. •

Gebike, Goodwin Appointed by Electro Refractories

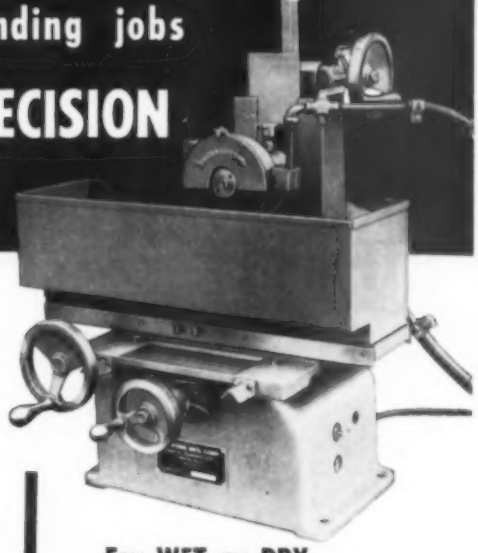
Harold Gebike, secretary-treasurer of Electro Refractories & Abrasives Corp., Buffalo, has been elected treasurer of

William H. Perks

Edwin E. McConnell

to do small grinding jobs to MICRO-PRECISION FAST...

you need the SANFORD Model SG SURFACE GRINDER



This unrivalled small parts grinder can be depended upon for micro accuracy. It's easy to use too . . . every hand wheel and operating switch is at your finger tips.

Designed and built by engineers and tool makers of rare foresight for tool, die and gage work, it has been constantly preferred after these many years of proven worth.

Write for fully illustrated literature, replacement parts and special attachments data with price list.

For WET or DRY grinding, specify optional equipment.

PARTIAL SPECIFICATIONS —

Chuck Surface — 3" x 5" or 4" x 6".
Table travel — 8", traverse 4".
Vertical head movement — 6".
Work area under 4" wheel — 6", with chuck — 4".
Standard grinding wheel — 4" x 3/8" x 1/2".
Spindle speed — approx. 5500 RPM.
Motor, 1/6 HP, single or 3 ph., dynamically balanced.
Dimensions — 23" x 30" x 27" high.
Net wt. approx. 160 lbs.

Representatives in major industrial areas

SANFORD MANUFACTURING CORP.
1026G Commerce Ave., Union, N. J.

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continued

the Spar Mica Corp., which is managed and partly owned by Electro.

William J. Goodwin has been appointed research engineer in the Electro Refractories crucible laboratory. •

Reynolds Metals Intensifies Automotive Sales

Reynolds Metals Company has announced an expansion of automotive sales activities to provide a more integrated and specialized sales and technical service for the automotive industry exclusively.

Fred H. Edgar, veteran aluminum sales executive was named Industrial Sales Manager, Automotive, to head the new grouping of automotive technical and sales personnel, according to DuPont Yager, Regional General Manager, Great Lakes Region.

Yager said the new alignment reflects the dramatic increase in the use of aluminum parts and products in 1957 auto production.

"With every model of every American car manufacturer employing aluminum in some form, either as exterior or interior decorative trim, under the hood or in other functional part application," Yager said, "Reynolds is enjoying an ever closer working relationship with automotive designers, engineers, manufacturing and sales executives.

"This willingness of manufacturers to 'think in aluminum' for current production as well as inviting us to help solve problems in advanced and future style and design, forecasts an ever expanding automotive use of aluminum," he said. •

Electro Has Record Sales Year

Electro Refractories & Abrasives Corp. registered record sales of $6,030,312 last year.

The annual consolidated report of the refractory, grinding wheel and crucible producer listed the sales total as 8.1 per cent above the previous high of $5,577,197 in 1955. Earnings were $414,665, equal to $1.35 per share, as compared to $400,138 and $1.33 per share a year earlier on a lesser number of shares.

Grant S. Diamond, president, said peak sales were chalked up despite the steel industry strike in July and August which adversely affected sales in the third quarter. •

Buckeye Officials Elected

Buckeye Tools Corporation, Dayton, Ohio, elected **Hal O. Gummere** executive vice-president, and **Ernest B. Meynard** vice-president, sales. Gummere was formerly vice-president and general manager, while Maynard was general sales manager. •

Pangborn Appoints Buckley General Sales Manager

Pangborn Corporation, Hagerstown, Md., manufacturers of blast cleaning and dust control equipment has announced the promotion of **Arthur J. Buckley** as general sales manager from his former position of sales manager.

Mr. Buckley joined Pangborn in 1952 as assistant sales manager and was elevated to sales manager in 1955. •

Armour Appoints Rogulic

The Coated Abrasives Division, Armour and Company, Alliance, Ohio, announces the appointment of **Jack M. Rogulic** as a new sales supervisor for the southern section of Cook County (Chicago) Illinois. •

Crane Packing Buys Plant In Vandalia, Ill.

Crane Packing Co. of Morton Grove, Ill., has purchased and put into operation a 30,000 sq. ft. one-story plant in Vandalia, Ill. Opening took place late in December, 1956. The Vandalia plant is being used to augment Crane Packing's home plant manufacturing facilities. •

TOP FIRMS SHOW

PROVED SAVINGS UP TO 75%

IN SET-UP AND GRINDING TIME WITH CONTINUOUS WORK INSPECTION AND INFINITE PRECISION

SIMPLIFIED OPERATION

When working with TUNGSTEN CARBIDE, STAINLESS STEEL, STELLITE or TOOL STEELS, VISUAL GRIND permits a semi-skilled operator to grind precision pieces without continued checking with the comparator. Automatic inspection is accomplished with the built in optical comparator.

Visit our plant . . . let us show you how VISUAL GRIND will speed production — cut costs.

Mail this Coupon NOW!

CLEVELAND GRINDING MACHINE
1660 Eddy Road Cleveland 12, Ohio

Gentlemen:

☐ Please have your representative call at our plant. The most convenient time would be (week) _____

☐ Phone for appointment

☐ Please send us complete information on the new VISUAL GRIND.

NAME _____ TITLE _____

COMPANY _____

ADDRESS _____

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William J. Martin

Michigan Abrasive Appoints Martin

William J. Martin, prominently identified for many years with abrasive service and sales work, has been appointed District Manager for Michigan Abrasive Co. in the Cleveland-Columbus-Pittsburgh Area. Martin was formerly a service engineer with Peninsular Grinding Wheel Co. He has been an officer and member of the Northeast Ohio Chapter of the American Foundry Society. •

Van Norman Names Two New Directors

Selby F. Greer and **Francis P. Healy** have been elected Directors of Van Norman Machine Company, it was announced today by Charles R. Crowder, President of the company.

Selby F. Greer

Francis P. Healy

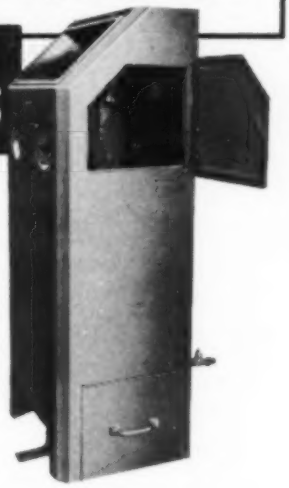
Mr. Greer is President of Van Norman Automotive Equipment Company while Mr. Healy is Vice President of the same company. •

Save with Sandblasting!

Do all these operations better, faster, at lower cost with

- Cleaning metal surfaces, molds, dies, tools
- Removing burrs, scale, carbon, rust, paint
- Preparing surfaces for plating and finishing
- Producing satin and matte finishes
- Stenciling, lettering, trademarks

Cabinet Type
LEIMAN SANDBLASTS



Whether you work on metal, glass, plastics, compositions . . . whether on production runs or single pieces, large or small—you'll find countless uses for versatile Leiman Sandblasts. Easily operated by unskilled help. Require little floor space. Use all types of abrasives. Well-designed, rugged, priced right, last for years.

Send for informative bulletin "Sandblasting", plus catalog showing complete line.

LEIMAN BROS., Inc. 109 Christie St., Newark 5, N. J.

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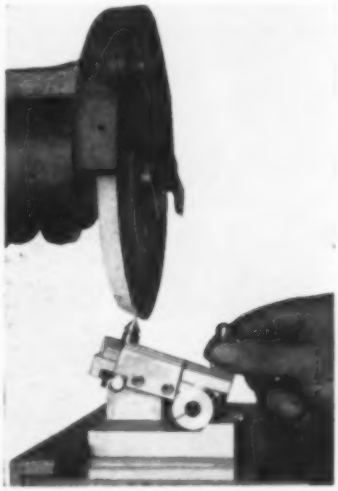

for precision ground ANGLES the *Sine* ANGLE wheel dresser is the answer . . .

The principle of the Sine Bar is utilized to insure extreme accuracy in dressing a grinding wheel to any desired angle.

Setting the tool and dressing the wheel takes only a few minutes and the necessity for complicated angular set ups is practically eliminated.

This fine but moderately priced tool is PRECISION made but sturdy enough to give many years of satisfactory service and will pay for itself in a short time.

Ask us for literature

AMERICAN STANDARD CO.
DEPARTMENT G **PLANTSVILLE, CONN.**

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continued

Carborundum Announces Record Sales in '56

The Carborundum Co., for the first time in its 65 year history, achieved sales in excess of $100,000,000 in 1956, compared with $89,800,000 in 1955, $70,000,000 in 1952, and sales of $37,000,000 in 1946. Indicating plans for further growth, General Clinton F. Robinson, president of the firm in Niagara Falls, N.Y., announced the continuation of expansion and modernization with a scheduled expenditure of $33,000,000 during 1957 and 1958.

Upwards of $5,000,000 will be spent for modernization and expansion of the company's divisions in the Niagara Frontier in 1957. Divisions in the Niagara Frontier participating in the $5,000,000 expenditure will be the Bonded Abrasives Div., Electro Minerals Div., and Globar Div. at Niagara Falls, Coated Abrasives Div. in Wheatfield, N.Y., Carborundum Metals, Akron, N.Y. and the Monofrax plant of the Refractories Div. in Falconer, N.Y.

The balance of the $33,000,000 is programmed for the Refractories Div. in Perth Amboy, N.J.; Zirconium plant in Parkersburg, W. Va., Resinoid abrasive wheel plant at Logan, O.; and an abrasive wheel plant in Van Wert, O., and other projects not yet announced.

•

Abrasive Engineers Assigned by Norton

Norton Company has appointed three new abrasive engineers and reassigned a fourth. **Robert T. Haigh** has been assigned to part of western New York state area with headquarters in Rochester. **Bruno D. Henrickson** will cover the part of western New York state in the Buffalo area.

Charles R. Garfield will call on accounts in Pittsburgh and northwest Pennsylvania and **David L. Lloyd-Rees** has been assigned to a territory consisting of Pittsburgh and southwestern Pennsylvania. Mr. Hendrickson has been an abrasive engineer since 1954. The others served previously as field engineers.

•

Cummings Now Campbell Sales Manager

Curtis D. Cummings, Sales Manager, Allison Division has been appointed to the position of Sales Manager of the Campbell Machine Division, American Chain & Cable Company, Inc., Bridgeport, Conn., according to an announcement by Hugh V. Allison, President and General Manager, Allison and General Manager, Campbell Divisions.

•

Stephenson Becomes Hoffman Export Chief

Revis L. Stephenson, vice president in charge of the industrial divisions of U.S. Hoffman Machinery Corporation, has been appointed director of export and foreign operations in addition to his present duties.

Speed-D-Burr Appoints Hallidie Machinery

Hallidie Machinery Co., Seattle, have been appointed by Speed-D-Burr Corporation, manufacturers of precision barrel finishing equipment, as technical sales and service representatives for the states of Washington, Oregon, Idaho, Montana and the territory of Alaska. With branch offices in Spokane, Washington, and Portland, Oregon, the Hallidie organization offers the on-the-spot engineering service required by Speed-D-Burr to serve its many customers in the fast growing northwest territory.

•

FOR PRECISION
Carbide Finishing
ELGIN DIAMOND
IN DYMO-C
...Designed for Carbides!
Where precision really counts, finishers specify ELGIN Diamond because they can be sure of:
consistent accuracy—uniform cutting action
flawless finishes every time, in less time
Actual field tests prove this new diamond abrasive up to 20% faster for finishing carbides.
Send for the DYMO-C bulletin today!
ABRASIVES DIVISION, Dept. A-1
ELGIN NATIONAL WATCH COMPANY
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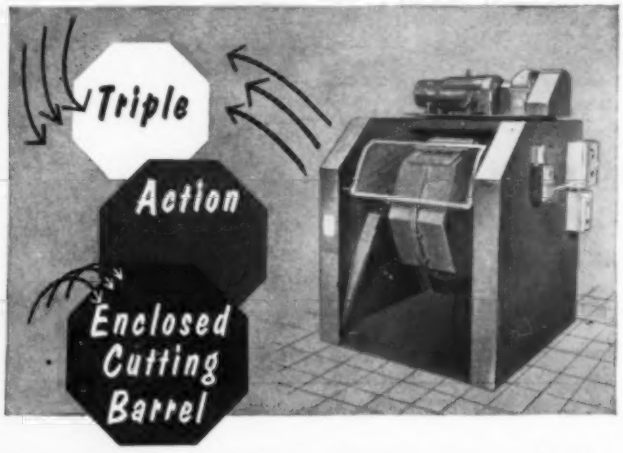

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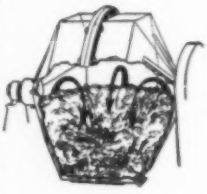

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Hall Appointed at GM

Harry D. Hall has been appointed director of Process Development Section at GM Technical Center. Hall succeeds **Glen R. Fitzgerald,** whose appointment as chief engineer, automotive products, of AC Spark Plug Division was announced recently. •

Pangborn Appoints Hall Representative

Pangborn Corporation, Hagerstown, Md., manufacturers of blast cleaning dust control equipment has announced the appointment of **Robert G. Hall** as blast descaling representative. In his new position, Hall will work on all industrial descaling applications as well as special steel mill equipment for mill roll blasting, ingot mold cleaning and other steel mill processes. •

Rivett Representative Moves

Schroeder Brothers Corporation, Pittsburgh representative for Rivett Air and Hydraulic Valves and Cylinders, has moved to a new location at Box 72 Nichol Ave., (Pittsburgh) McKees Rocks, Pa., phone SPaulding 1-4810. This move has increased floor space by 10,000 square feet, thus enabling the company to better serve customer needs. •

Eastin Becomes Brush Electronics Sales Chief

Maurice R. Eastin has been appointed general sales manager of Brush Electronics Company, Cleveland, a division of Clevite Corporation, according to an announcement by C. B. Hoffman, Brush vice president.

For the past four years, Eastin has been sales manager and assistant general manager of the Perfex Division of General Controls Company. Prior to 1952, he was associated with Minneapolis-Honeywell Company for six years, becoming national sales manager of its Transportation Division. •

Crane Packing Announces Four Executive Promotions

Four executive promotions have been announced from the home office of Crane Packing Co. in Morton Grove, Ill. (Chicago Suburb). **Carl E. Schmitz** becomes Executive Vice President. He was formerly Vice President in charge of sales.

Vance E. Vorhees is now Vice President In Charge of Sales. **B. H. Stenberg** has been named Vice President In Charge of Manufacturing, and **E. H. Stubenrauch** becomes Assistant General Sales Manager. •

Spotswood Named Division Manager for Aro Air Tools

The Aro Equipment Corporation of Bryan, Ohio, manufacturer of industrial air tools, has appointed **William S. Spotswood** as Division Manager, Government Sales in the company's Air Tool Division. From his headquarters in Washington, D.C., he will cover technical procuring agencies throughout the U.S.

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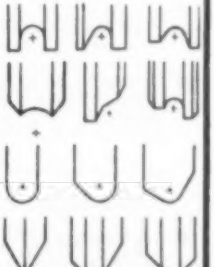

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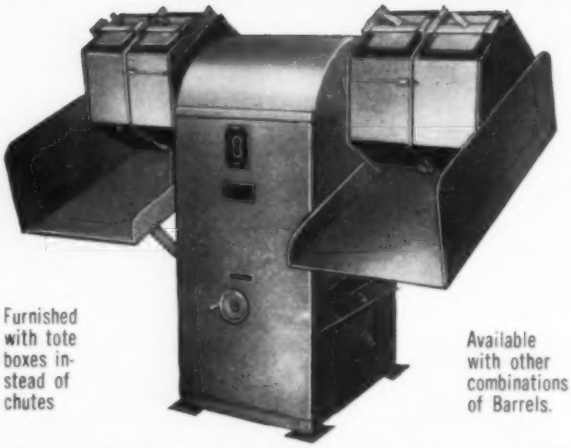

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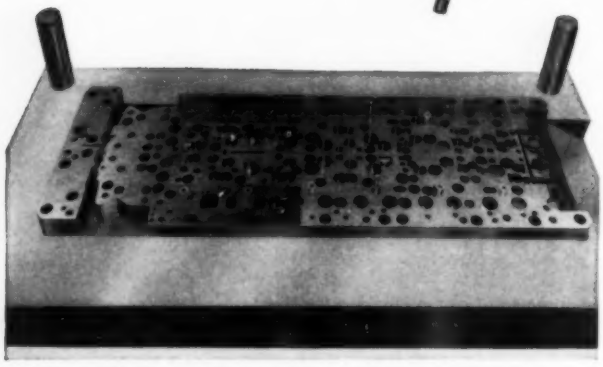

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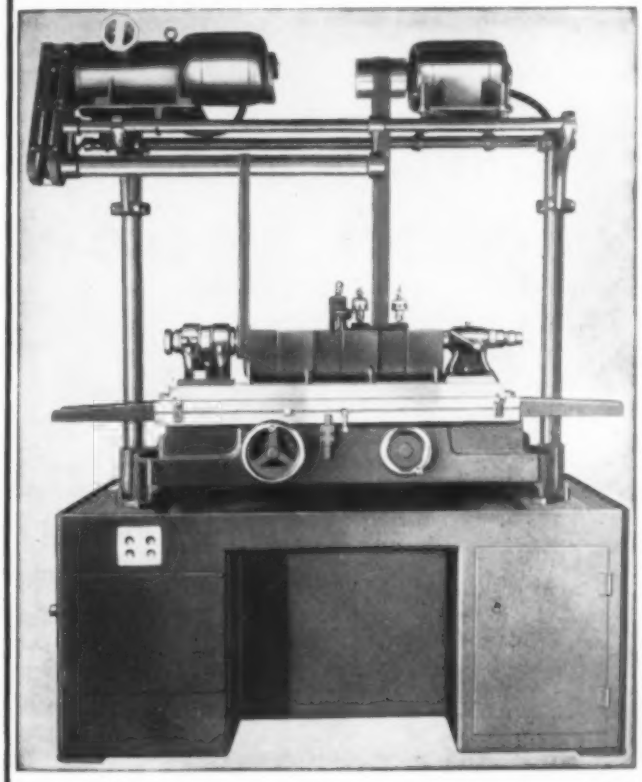

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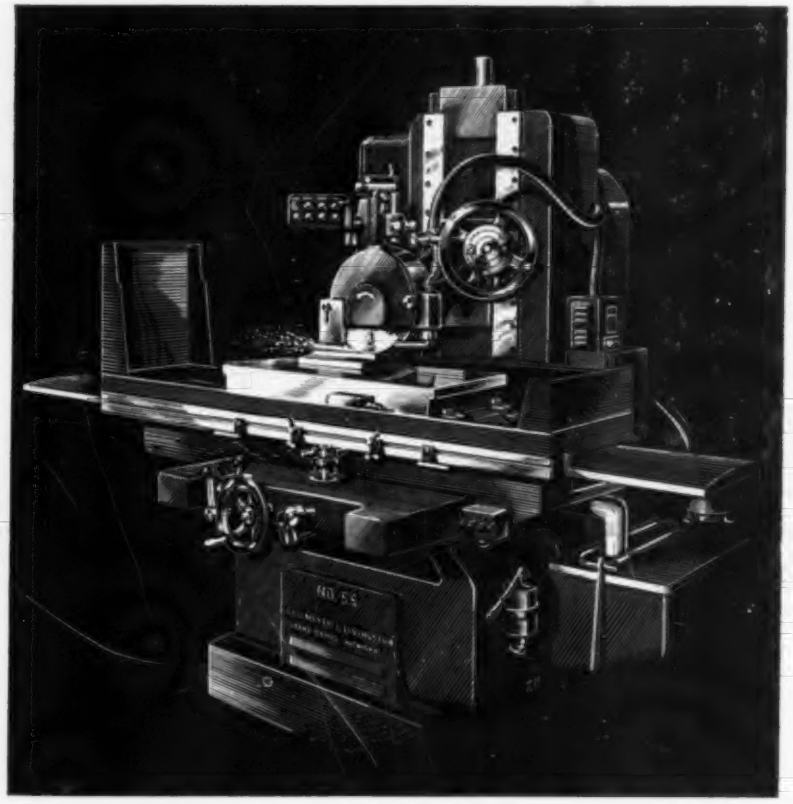

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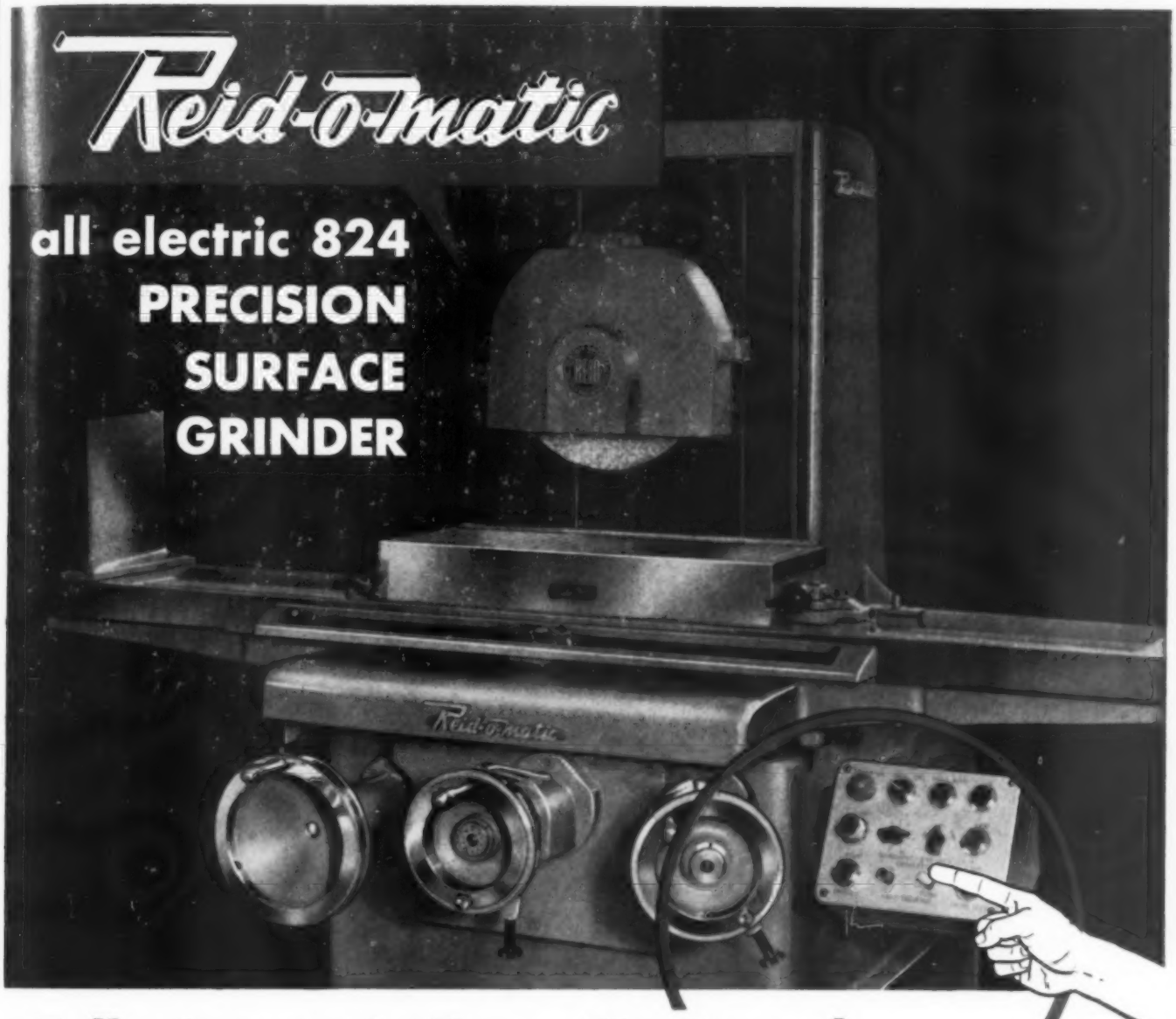

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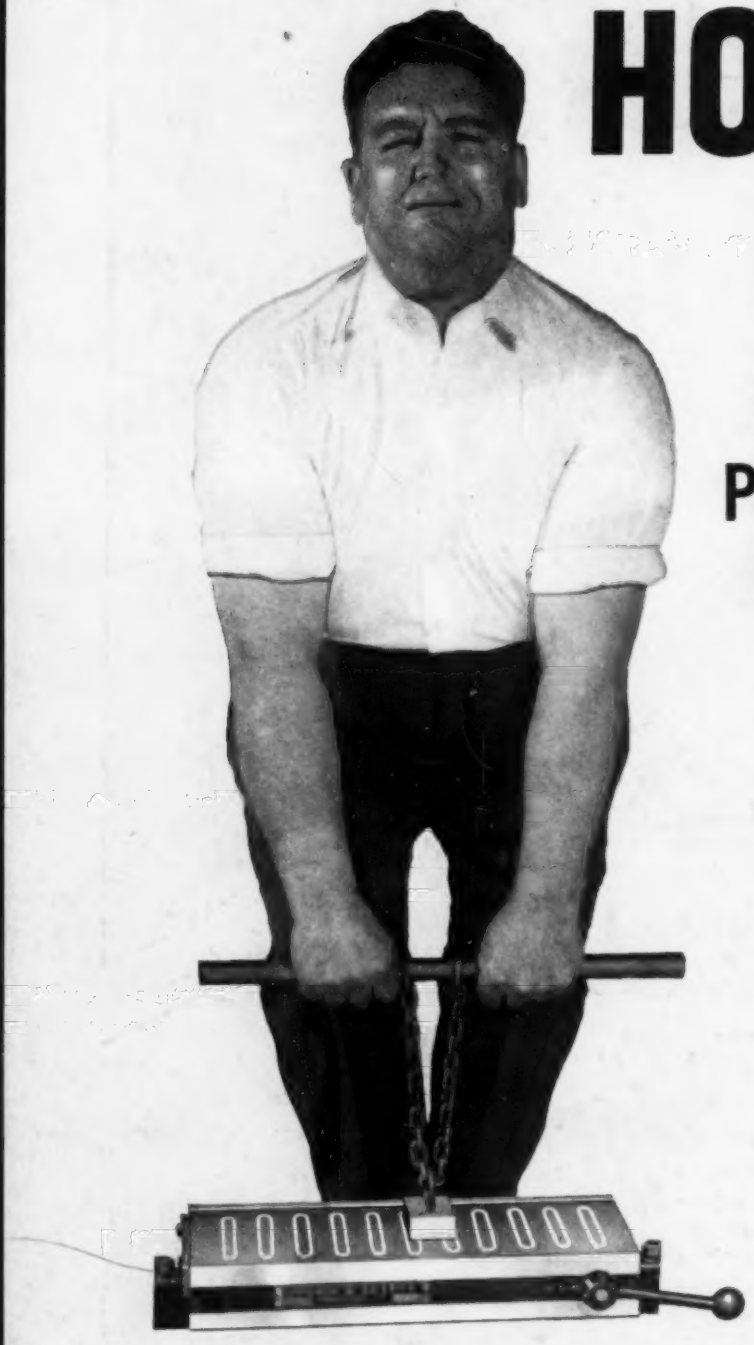

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